STUDIES ON BOREAL AGROMYZIDAE (DIPTERA). XII. *PHYTOMYZA* AND *CHROMATOMYIA* MINERS ON ASTEREAE (COMPOSITAE)

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Quaestiones Entomologicae
12: 239-278 1976

Seventeen species of the Phytomyza albiceps *group and four species of* Chromatomyia *are recorded as leaf-miners of Astereae in the holarctic region. These include seven new species from North America, as follows:* Phytomyza despinosa *n. sp. on* Aster sibiricus *L. (type-locality Lake Teslin, Yukon Territory),* Phytomyza phalangites *n. sp. on* Aster *(type-locality Edmonton, Alberta),* Phytomyza astotinensis *n. sp. on* Solidago *(type-locality Elk Island National Park, Alberta),* Phytomyza scopulina *n. sp. on* Erigeron *and* Solidago *(type-locality Jasper National Park, Alberta),* Phytomyza peregrini *n. sp. on* Erigeron peregrinus *(Pursh) (type-locality Jasper National Park, Alberta),* Phytomyza ovimontis *n. sp. on* Erigeron caespitosus *Nutt. (type-locality Kluane Lake, Yukon Territory) and* Chromatomyia thermarum *n. sp. on* Erigeron philadelphicus *L. (type-locality Liard Hot Springs, British Columbia). Two names are newly synonymized,* Phytomyza asteribia *Hering (* = P. erigerophila *Hering) and* P. simmi *Beiger (* = P. virgaureae *Hering).* Phytomyza erigerophila *Hering, previously known only from Europe, is recorded in North America for the first time.*

Dix-sept espèces du groupe Phytomyza albiceps *et quatre espèces de* Chromatomyia *sont signalées comme mineuses dans les feuilles des Astereae. Sept espèces nouvelles d'Amérique du nord sont inclues, tel que:* Phytomyza despinosa *n. sp. sur l'*Aster sibiricus *L. (localité-type Lac Teslin, Territoire du Yukon),* Phytomyza phalangites *n. sp. sur l'*Aster *(localité-type Edmonton, Alberta),* Phytomyza astotinensis *n. sp. sur la* Solidago *(localité-type Parc National Elk Island, Alberta),* Phytomyza scopulina *n. sp. sur l'*Erigeron *et* Solidago *(localité-type Parc National Jasper, Alberta),* Phytomyza peregrini *n. sp. sur l'* Erigeron peregrinus *(Pursh) (localité-type Parc National Jasper, Alberta),* Phytomyza ovimontis *n. sp. sur l'* Erigeron caespitosus *Nutt. (localité-type Lac Kluane, Territoire du Yukon) et* Chromatomyia thermarum *n. sp. sur l'*Erigeron philadelphicus *L. (localité-type Thermales de Liard, Colombie britannique). Deux noms sont de nouveau synonymisés,* Phytomyza asteribia *Hering (* = P. erigerophila *Hering) et* P. simmi *Beiger (* = P. virgaureae *Hering).* Phytomyza erigerophila *Hering, connue seulement d'Europe auparavant, est signalée pour la première fois en Amérique du nord.*

Siebzehn Arten der Phytomyza albiceps*-Gruppe und vier* Chromatomyia*-Arten werden als Blattminierer von Astereae besprochen. Unter diesen sind folgende sieben nordamerikanische Arten neu:* Phytomyza despinosa *n. sp. an* Aster sibiricus *L. (Fundort des Typus: Lake Teslin, Yukon Territorium),* Phytomyza phalangites *n. sp. an* Aster *(Fundort des Typus: Edmonton, Alberta),* Phytomyza astotinensis *n. sp. an* Solidago *(Fundort des Typus: Elk Island Nationalpark, Alberta),* Phytomyza scopulina *n. sp. an* Erigeron *und* Solidago *(Fundort des Typus: Jasper Nationalpark, Alberta),* Phytomyza peregrini *n. sp. an* Erigeron peregrinus *(Pursh) (Fundort des Typus: Jasper Nationalpark, Alberta),* Phytomyza ovimontis *n. sp. an* Erigeron caespitosus *Nutt. (Fundort des Typus: Kluane Lake, Yukon Territorium) und* Chromatomyia thermarum *n. sp. an* Erigeron philadephicus *L. (Fundort des Typus: Liard Hot Springs, Britisch Kolumbien). Zwei Namen werden neu synonymisiert:* Phytomyza asteribia *Hering (* = P. erigerophila *Hering) und* P. simmi *Beiger (* = P. virgaureae *Hering).* Phytomyza erigerophila *Hering, bisher nur aus Europa bekannt, wird erstmals für Nordamerika nachgewiesen.*

In this paper I continue the revision of Compositae-miners of the *Phyotmyza albiceps* group initiated in Parts II, VI and VIII of this series (Griffiths, 1972, 1974b & 1974d) by treating the species known from Astereae. The *Chromatomyia* miners of Astereae are also treated. This revision has resulted in reduction in the number of European species recognized through two new synonymies, but I am able to increase the total for North America by describing seven new species from my own breedings and recording one species previously known only from Europe (*Phytomyza erigerophila* Hering). This is the only species treated here which has been confirmed to have a holarctic distribution. But others will doubtless be added when the fauna of Eastern Siberia is investigated.

In writing this paper I have tried to consider all relevant information in the European, Japanese and North American literature. Certain records of leaf-mines and immature stages in Central Asia and India are , however, omitted from consideration, since it is premature to speculate on their identity when no adult flies have been obtained.

This paper includes a complete set of figures of the leaf-mines of North American species, but not of European species since good figures are already available in the literature.

The large taxa *Aster* and *Erigeron,* as presently delimited, include some diverse components and will doubtless be further revised. They clearly do not represent faunal units (groups of plants supporting substantially the same fauna of phytophagous insects), since I have not found any species whose host range seems coincident with *Aster* and *Erigeron* in the present sense. Some host vicariance on different species of these "genera" is apparent (notably *Phytomyza asterophaga* Spencer on *Aster conspicuus* Lindl., sister-species of *P. ciliolati* Spencer on certain other *Aster* species; and *Chromatomyia thermarum* n. sp. on *Erigeron philadelphicus* L., sister-species of *C. erigerontophaga* (Spencer) on certain other *Erigeron* species); and there are two cases of species whose host range combines parts of these "genera" with some other component *(Phytomyza erigerophila* Hering on several *Erigeron* species and *Aster amellus* L., and *P. scopulina* n. sp. on certain *Erigeron* species and *Solidago).*

The botanical nomenclature followed in this paper for European species is non-controversial and needs no special comment. For North American species I have generally followed Hultén (1968) and Moss (1959), except that I insist on listing *Erigeron debilis* (Gray) as a full species, not as a "variety" of *E. acris* L. The floral characters of this plant are distinct from those of *Erigeron acris* L. subsp. *politus* (E. Fries) (= var. *asteroides* in Moss' sense), it has a different growth form and occupies a different habitat. The (no doubt incorrect) inclusion of *E. debilis* under *E. acris* is entomologically quite misleading, since my impression from extensive field work on Mount Cavell is that it supports a different mining fauna. Another difference between my nomenclature and that of Moss' (1959) Flora of Alberta is that I follow Hultén in listing the plant called *Solidago lepida* DC. by Moss as *S. canadensis* L.

See the first paper of this series (Griffiths, 1972a) for explanation of certain terms and abbreviations used throughout. The holotypes of all new species described here will be deposited in the Canadian National Collection (Ottawa).

DIAGNOSIS

The key to North American species of the *Phytomyza albiceps* group presented in Part VI (Griffiths, 1974b: 105) has required considerable expansion and amendment to incorporate eight additional species treated in this paper (six described as new, one previously known only from Europe, and *Phytomyza ciliolati* Spencer which can now be included in the key following study of males). The amendments to incorporate these eight species have been consolidated with those previously proposed in Part VIII (Griffiths, 1974d), where two new species of this group were described. A short amendment to the key to North American species of *Chromatomyia* (Griffiths, 1974a: 39) is also needed to incorporate one new species.

Keys with holarctic coverage to *Phytomyza* and *Chromatomyia* mines on the four groups of Astereae from which most of the material treated here was obtained (*Aster, Bellis, Erigeron* and *Solidago*) are also presented below. In using these keys, it should be appreciated that they include only part of the agromyzid fauna, since these plants also support leaf-mining species of *Ophiomyia, Nemorimyza, Calycomyza, Liriomyza* and *Napomyza.*

Consolidated Amendments to Key to North American Species of *Phytomyza albiceps* Group

6. (5) Aedeagus with pigmented distiphallus well developed (Fig. 24). Costal section mg_2 less than 2.5 times as long as mg_4 ..... 6a
– Aedeagus as figured by Griffiths (1973, Fig. 7); distal section with only weak traces of terminal pigmentation (distiphallus). Costal ratio mg_2/mg_4 3.4-3.5 ..... *P. sitchensis* Griffiths

6a. (6) Frons largely ochreous yellow to brown, becoming clear yellow to whitish posteriorly on either side of contrastingly black ocellar plate. Aedeagus as figured by Griffiths (1974d, Fig. 15), with sclerites of medial lobe conspicuously angled near ..... *P. demissa* Spencer
– Frons dark brown, not contrastingly paler than black ocellar plate. Aedeagus as Fig. 24, with sclerites of medial lobe more uniformly curved. ..... *P. ovimontis* n. sp., p. 255

10. (9) Aedeagus as Fig. 25, with left basal sclerite short (less than half as long as right basal sclerite) and medial lobe absent ..... *P. erigerophila* Hering, p. 256
– Left basal sclerite of aedeagus about as long as right; medial lobe with conspicuous sclerites 10a

10a. (10) Aedeagus as Fig. 1, with row of 4-6 short spinules on area of weakly pigmented sclerotization confluent with right basal sclerite at base of basal section; distal section unpigmented or with patches of weak pigmentation 10b
– Aedeagus not as above; spinules absent or distributed otherwise 10c*

10b.(10a) Distal section of aedeagus with distinct patches of pigmentation (Fig. 1). Wing length: ♂, 2.35-2.5 mm; ♀, 2.4-2.8 mm. ..... *P. asterophaga* Spencer, p. 244
– Distal section unpigmented or at most with pair of weak spots on terminal tubules and small basal spot (Fig. 4). Wing length: ♂, 2.0-2.25 mm; ♀, 2.1-2.4 mm. ..... *P. ciliolati* Spencer, p. 245

10c.(10a) Distal section of aedeagus without terminal pigmentation (distiphallus) 10d
– Distal section of aedeagus with terminal bifid area (distiphallus) pigmented ... 16

10d.(10c) Aedeagus as Fig. 17, with band of 15-20 spinules on basal section. Centre of frons brownish anteriorly, becoming yellow posteriorly ..... *P. solidaginophaga* Sehgal, p. 252
– Aedeagus not as above. Centre of frons entirely yellow 11

17. (16) Aedeagus as figured by Spencer (1969, Fig. 452), with strips of sclerotization below main sclerites of medial lobe; pigmented terminal tubules (distiphallus) short ..... *P. lanati* Spencer
– Aedeagus without strips of sclerotization below main sclerites of medial lobe; pigmented terminal tubules (distiphallus) long and conspicuous 17a

17a. (17) Sides of mesonotum broadly yellow. Aedeagus as Fig. 8-9. ..... *P. solidaginivora* Spencer, p. 246
– Sides of mesonotum dark. Aedeagus as Fig. 5-6 .... *P. despinosa* n. sp., p. 246

18. (16) Aedeagus as Fig. 10, with spinules arranged in two dorsal groups, one along margin of left basal sclerite and one on area of fusion of basal sclerites 18a
– Aedeagus with spinules arranged otherwise 18d

18a. (18) Sides of mesonotum extensively yellowish 18b
– Sides of mesonotum dark. 18c

18b. (18a) Mesopleuron yellowish only on dorsal quarter; other pleura largely dark, with pale

* See also the new species described in the Postscript.

coloration only along sutures. Aedeagus as Fig. 10. Wing length: ♂, 2.3-2.7 mm; ♀, 2.4-2.9 mm ..... *P. phalangites* n. sp., p. 247

– Mesopleuron yellowish on dorsal third; anterior parts of pteropleuron also pale in most specimens. Distal section of aedeagus as Fig. 13, with pigmentation extending further basally as pair of ventral stripes. Wing length: ♂, 2.2-2.3 mm; ♀, 2.5 mm ..... *P. astotinensis* n. sp., p.

18c. (18a) Frons largely orange-yellow, with orbits at most infuscated along eye margins; face yellow at sides, infuscated only in antennal pits. Costal ratio mg_2/mg_4 2.1-2.7 (mean 2.4) ..... *P. scopulina* n. sp., p. 249

– Frons deep orange-yellow to orange-brown centrally, with orbits largely ochreous to brownish; face entirely infuscated. Costal ratio mg_2/mg_4 2.0-2.3 (mean 2.2) ..... *P. peregrini* n. sp., p. 250

18d. (18) (as previous couplet 18)

21. (19) Sides of thorax extensively yellowish white. Aedeagus as figured by Griffiths (1974d, Fig. 4-5), with compact row of spinules on left side of basal section ..... *P. alaskana* Griffiths

– Thorax largely dark 22

22. (21) Aedeagus as figured by Griffiths (1972b, Fig. 1-2), with spinules in dense lateral patches on distal half of basal section. Costal ratio mg_2/mg_4 2.8-3.4 ..... *P. alpina* Groschke

– Aedeagus as figured by Griffiths (1974d, Fig. 18-19), with spinules of basal section mostly arranged in long row. Costal ratio mg_2/mg_4 1.9-2.1 ..... *P. saxatilis* Griffiths

Amendment to Key to North American Species of *Chromatomyia*

4. (2) Third antennal article somewhat enlarged (height 0.4-0.45 times eye height). Male genitalia as Fig. 31-36 ..... 4a

– Third antennal article not enlarged 5

4a. (4) Costal ratio mg_2/mg_4 1.0-1.3. Centre of frons dark brown anteriorly. Aedeagus as Fig. 31 ..... *C. erigerontophaga* (Spencer), p. 261

– Costal ratio mg_2/mg_4 1.5-1.9. Centre of frons ochreous yellow to orange-brown anteriorly. Aedeagus as Fig. 35. ..... *C. thermarum* n. sp., p. 263

Key to *Phytomyza* and *Chromatomyia* Mines on *Aster*

1 Puparia formed inside leaf, with anterior spiracles turned downwards, projecting through epidermis 2

1′ Puparia normally formed outside leaf 4

2 (1) Mine blotchy terminally. Europe. On *A. alpinus* L. ..... *Phytomyza pieninica* Nowakowski, p. 255

2′ Mine entirely linear .... (*Chromatomyia syngenesiae* group) 3

3 (2′) Posterior spiracles of third instar larva and puparium with 24-33 bulbs. Europe. On *A. tripolium* L. ..... *Chromatomyia asteris* (Hendel), p. 260

3′ Posterior spiracles of third instar larva and puparium with 6-12 bulbs. Old World. ..... *Chromatomyia horticola* (Goureau), p. 261

4 (1′) Mine primary blotch, in many cases communal formed by feeding of more than one larva (Fig. 39). North America ..... *Phytomyza phalangites* n. sp., p. 247

4′ Mine basically linear, at most with secondarily blotchy areas formed by convoluted linear channels 5

5 (4′) Faeces deposited more or less continuously in conspicuous black thread (Fig. 38). North America ..... *Phytomyza ciliolati* Spencer, p. 245*
5′ Faeces deposited as particles or in short beaded strips 6
6 (5′) Mine 17-22 cm long (Fig. 37). North America. On *A. conspicuus* Lindl. ..... *Phytomyza asterophaga* Spencer, p. 244
6′ Mine shorter. On other species of *Aster* 7
7 (6′) Puparia very small, 1.4-1.75 mm long. Europe. On *A. amellus* L ..... *Phytomyza erigerophila* Hering, p. 256
7′ Puparia normally larger 8
8 (7′) Faeces deposited in beaded strips on alternate sides of mine (Fig. 41). North America ..... *Phytomyza solidaginivora* Spencer, p. 246
8′ Faeces deposited as discrete particles 9
9 (8′) On *A. bellidiastrum* (L.). Europe ..... *Phytomyza hoppi* Hering, p. 254
9′ On *A. sibiricus* L. North America..... *Phytomyza despinosa* n. sp., p. 246

Key to *Phytomyza* Mines on *Bellis*

1 Posterior spiracles of third instar larva and puparium very large, with 31-44 bulbs. Japan ..... *P. japonica* Sasakawa, p. 255
1′ Posterior spiracles of third instar larva and puparium with 12-23 bulbs. Europe 2
2 (1′) Mine entirely linear ..... *P. virgaureae* Hering, p. 251
2′ Mine linear at origin, but soon broadened into blotch. *P. bellidina* Hering, p. 253

Key to *Phytomyza* and *Chromatomyia* Mines on *Erigeron*

1 Puparia formed inside leaf, with anterior spiracles turned downwards, projecting through epidermis ... (*Chromatomyia*) 2
1′ Puparia normally formed outside leaf ..... (*Phytomyza albiceps* group) .. 4
2 (1) Larva feeding mainly in petiole and basal part of midrib, in most cases entering more than one leaf to complete development; mine channels in leaf parenchyma, when present, radiating from base of blade (Fig. 48-49). North America ..... .(*Chromatomyia erigerontophaga* group) 3
2′ Larva forming continuous linear mine in leaf parenchyma, normally not entering petiole. Old World ..... *Chromatomyia horticola* (Goureau), p. 261
3 (2) On *E. philadelphicus* L..... *Chromatomyia thermarum* n. sp., p. 263
3′ On small arctic species of *Erigeron* ..... *Chromatomyia erigerontophaga* (Spencer), p. 261
4 (1′) Mine primary blotch (Fig. 46). Yukon. On *E. caespitosus* Nutt. ..... *Phytomyza ovimontis* n. sp., p. 255
4′ Mine linear at least initially. On other species of *Erigeron* 5
5 (4′) On *E. peregrinus* (Pursh). North America... *Phytomyza peregrini* n. sp., p. 250
5′ On other species of *Erigeron* 6
6 (5′) Puparia small, 1.4-1.75 mm long. Holarctic ..... *Phytomyza erigerophila* Hering, p. 256
6′ Puparia mostly larger, 1.7-2.0 mm long. North America ..... *Phytomyza scopulina* n. sp., p. 249

Key to *Phytomyza* Mines on *Solidago*

1 Europe..... 2
1′ North America..... 3

* See also the new species described in the Postscript.

2 (1) Mine 6-9 cm long, with exit slit in most cases on upper surface of leaf. Puparia 1.65-1.75 mm long ..... *P. solidaginis* Hendel, p. 258
2′ Mine 10-12 cm long, with exit slit on lower surface of leaf. Puparia 1.8-2.2 mm long ..... *P. virgaureae* Hering, p. 251
3 (1′) Mine gradually widening linear-blotch (Fig. 44). Larvae feeding in late vii-viii ..... *P. scopulina* n. sp., p. 249
3′ Mine entirely linear (Fig. 42-43) 4
4 (3′) Larvae feeding in vi ..... *P. solidaginophaga* Sehgal, p. 252
4′ Larvae feeding in viii-ix ..... *P. astotinensis* n. sp., p. 248

TREATMENT OF SPECIES

(a) The *Phytomyza albiceps* group

The Astereae support a rich fauna of species belonging to the *Phytomyza albiceps* group, in the sense proposed in my discussion in Part II (Griffiths, 1972b: 380). These are mostly rather typical members of the group in respect of structure and life-history. Two species whose aedeagus is highly modified with reduced sclerotization (*P. erigerophila* Hering and *P. solidaginis* Hendel) must surely also be included as apomorphous members of the *P. albiceps* group, since the presence of a row of spinules on the basal section of the aedeagus is a feature otherwise found only in members of this group. Deviation from the normal practice of leaving the mine before puparium formation is shown by one species (*P. pieninica* Nowakowski).

Phytomyza asterophaga Spencer 1969

Phytomyza asterophaga Spencer. Spencer, 1969: 230. Holotype ♂, Wabamun (Alberta), in K. A. Spencer's collection.

Adult. – Head with orbits not or only slightly projecting above eye in lateral view; genae in middle 0.25-0.35 times eye height; eyes with only sparse fine pubescence. Frons at level of front ocellus about twice width of eye. Only one ors (posteriorly directed) present; two strong ori (inwardly directed), anterior half to almost fully as long as posterior (also short third ori on one side in two females); orbital setulae more or less one-rowed. Peristomal margin with vibrissa and 2-5 upcurved peristomal setulae. Third antennal article rounded distally, with short fine pubescence.

3 + 1 dc; mesonotal setulae rather long; acr in 3-5 rows; 5-11 presutural ia; 3-7 postsutural ia; inner pa about 0.33 as long as outer pa.

Second cross-vein (m-m) absent. Costal ratio mg_2/mg_4 2.6-3.05 (mean 2.8). Wing length: ♂, 2.35-2.5 mm; ♀, 2.4-2.8 mm (mean 2.6 mm).

Frons largely clear yellow, with ocellar plate and vertex contrastingly black (vte on dark ground; vti on boundary between dark and pale ground); orbits clear yellow, at most with faint traces of infuscation around bases of orbital setae. Face largely infuscated. Genae yellow. Occiput black. Antennae with first article brown to dark brown, second and third articles black. Palpi black; labella yellow. Thorax almost entirely dark, strongly grey-dusted (only weakly shining); mesonotum with traces of pale coloration only at corners of humeral calli; mesopleuron with narrow whitish dorsal band along notopleural suture; seam of mesopleural suture whitish; wing base and squamae yellowish white, latter with dark fringe. Legs with coxae, trochanters and femora largely dark, with tips of femora contrastingly yellow; tibiae and tarsi yellow-brown to dark brown. Abdomen largely dark brown. Basal cone of ovipositor (♀) grey-dusted on dorsal surface on basal third to half.

Male postabdomen with 8th sternum fused with 6th tergum. Telomeres represented by densely setulose apical lobes of periandrium, not delimited by suture. Pregonites large, scarcely pigmented, extending ventrally (shielding base of aedeagus at rest). Aedeagus as Fig. 1-2; basal sclerites long and narrow, slightly sinuate; row of 4-6 short spinules on area of weakly pigmented sclerotization (confluent with right basal sclerite) at base of basal section; sclerites of medial lobe fused distally, forming slender symmetrical V in ventral view, appearing distinctly recurved in lateral view; distal section with pair of divergent terminal tubules (distiphallus) arising from cylindrical area of sclerotization about ejaculatory duct, partly unpigmented but with distinct patches of weak pigmentation at base and distally. Ejaculatory apodeme as Fig. 3.

The aedeagus has previously been figured by Spencer (1969).

Puparium and third instar larva. – Mandibles with two alternating teeth; right mandible longer than left. Anterior spiracles with two short horns, with 9-12 bulbs in widely open ellipse; posterior spiracles on short conical projections, only slightly raised above level of last segment, with 12-15 bulbs in broad oval ellipse (nearly circular in some specimens). Puparia dark brown to black, 2.0 - 2.1 mm long, with prominent anal lobes.

Mine. – Larvae leaf-miners on *Aster conspicuus* Lindl. Mine (Fig. 37) entirely linear, 17-22 cm long, 1.5 - 2.5 mm wide terminally; faeces deposited mostly as fine particles along sides of mine, in some cases partly forming short beaded strips or threads; mine formed largely on upper surface of leaf (where appearing whitish in reflected light when fresh), but with initial channel on lower surface; larvae leaving leaf through semicircular slit on lower surface before puparium formation.

The mine has previously been figured by Spencer (1969).

Material examined. – 2 ♂♂ 8 ♀♀ from larvae 18-22.vi.71 on *Aster conspicuus* Lindl., Elk Island National Park, Alberta, emerged 9-11.v.72, leg. G. C. D. Griffiths.

Remarks. – The only previously recorded specimens are Spencer's (1969) types bred from larvae collected 1.vii.66 on *Aster conspicuus* Lindl. at Wabamun (Alberta). This species seems confined to *Aster conspicuus* in Central Alberta, being replaced on other Asters by its sister-species *P. ciliolati* Spencer. The mines appear early in the season, and there is only a single generation a year.

In addition to the localities stated above, I can confirm that this species is common in ravines and the river valley in the City of Edmonton.

Phytomyza ciliolati Spencer 1969

Phytomyza ciliolati Spencer. Spencer, 1969: 234. Holotype ♀, Wabamun (Alberta), in K. A. Spencer's collection.

Adult. – As described for *P. asterophaga,* except as follows.

Genae in middle 0.2 - 0.3 times eye height. Normally only one ors (as in *asterophaga*), but posterior ors present at least on one side in three specimens (including one male with two equal ors on one side, but only one ors on the other); variation of ori as in *asterophaga* (with short third ori on one side in one male). 2 - 6 upcurved peristomal setulae. 5 - 9 presutural ia; 3 - 8 postsutural ia. Costal ratio mg_2/mg_4 2.2 - 2.75 (means: ♂, 2.35; ♀, 2.55). Wing length: ♂, 2.0 - 2.25 mm (mean 2.15 mm); ♀, 2.1 - 2.4 mm (mean 2.2 mm).

Orbits distinctly infuscated along eye margins in most specimens (but entirely yellow, as in *asterophaga*, in a few). Mesonotum in some specimens with traces of whitish or light brown coloration in sutural triangle and on postalar callus (but in others not paler than described for *asterophaga*).

Aedeagus with pigmentation of distal section further reduced (Fig. 4), either entirely absent or consisting at most of pair of weak spots on terminal tubules (distiphallus) and small basal spot. Ejaculatory apodeme in most specimens as in *asterophaga,* but narrower in the specimen bred from *Aster puniceus* L.

Puparium and third instar larva. – Similar to those of *P. asterophaga,* but smaller and with, on average, more numerous bulbs on posterior spiracles. Anterior spiracles with 11-12 bulbs; posterior spiracles with 15-21 bulbs. Puparia 1.5 - 1.8 mm long.

Mine. – Larvae leaf-miners on *Aster.* Mine (Fig. 38) entirely linear, 10-13 cm long, 1.5-2 mm wide terminally; faeces deposited more or less continuously in conspicuous black thread; mine formed largely on upper surface of leaf (where appearing white or greenish white in reflected light when fresh), but with inconspicuous initial channel on lower surface; larvae leaving leaf through semicircular slit, in most cases on lower surface, before puparium formation.

The mine has previously been figured by Spencer (1969).

Material examined. – 2 ♂♂ from larvae 4-29.vii.71 on *Aster ciliolatus* Lindl., Elk Island National Park, Alberta, emerged 25.vii & 11.viii.71, leg. G. C. D. Griffiths; 1 ♂ from larva 1.vii.71 on *Aster puniceus* L., same locality, emerged 19.vii.71, leg. G. C. D. Griffiths; 5 ♀♀ from larvae 7.viii.71 on *Aster laevis* L., same locality, emerged 22-28.viii.71 and 11.v.72 (1 ♀), leg. G. C. D. Griffiths; 1 ♀ from larva 20.vii.75 on *Aster modestus* Lindl., same locality, emerged 6.viii.75, leg. G. C. D. Griffiths. 2 ♂♂ from larvae 12.ix.73 on *Aster hesperius* Gray, Opal Sandhills (near Redwater), Alberta, emerged 25.iv & 23.v.74, leg. G. C. D. Griffiths.

Remarks. – The only previously recorded specimen is Spencer's holotype (♀) bred from larvae collected 1.vii.66 on *Aster ciliolatus* Lindl. at Wabamun (Alberta). The apomorphous aedeagal structure clearly indicates that this species is the sister-species of *P. asterophaga,* from which the adult differs mainly in respect of smaller size and lower costal ratio, as well as the virtual absence of pigmentation on the distal section of the aedeagus. A few other differences suggested by Spencer have not been confirmed by my additional material. The mines of *P. ciliolati* are very characteristic, and can be readily identified in the field. Unlike *asterophaga, P. ciliolati* is multivoltine with 2-3 generations a year in Central Alberta.

In addition to the localites stated above, I can confirm that this species is common in ravines and the river valley of the City of Edmonton on the four host-plants listed above.

Phytomyza despinosa new species

Adult. – Head with orbits not or only slightly projecting above eye in lateral view; genae in middle 0.2 - 0.3 times eye height; eyes with only sparse fine pubescence. Frons at level of front ocellus about twice width of eye. Ors directed posteriorly, ori directed inwardly; posterior ors 0.5 - 0.8 times as long as anterior ors; normally two ori, anterior 0.3 - 0.5 times as long as posterior (with additional short third pair of ori in one female); orbital setulae more or less one-rowed. Peristomal margin with vibrissa and 3-5 upcurved peristomal setulae. Third antennal article rounded distally, with short fine pubescence.

3 + 1 dc; mesonotal setulae rather long; acr in about 4 rows; 7-12 presutural ia; 5-7 postsutural ia; inner pa about 0.33 as long as outer pa.

Second cross-vein (m-m) absent. Costal ratio mg_2/mg_4: ♂, 2.1; ♀, 2.45-2.5. Wing length: ♂, 2.6 mm; ♀, 2.8 - 2.95 mm.

Frons largely clear yellow, with ocellar plate and vertex contrastingly black (vte on dark ground; vti on boundary between dark and pale ground); orbits yellow, at most with traces of infuscation around bases of orbital setae. Face largely yellow, only weakly infuscated in antennal pits. Genae yellow. Occiput black. Antennae with first article brown to dark brown, second and third articles black. Palpi black; labella yellow. Thorax almost entirely dark, strongly grey-dusted (only weakly shining); mesonotum with traces of pale coloration only at corners of humeral calli; mesopleuron with narrow whitish dorsal band along notopleural suture; seam of mesopleural suture whitish; wing base and squamae yellowish white, latter with dark fringe. Legs with coxae, trochanters and femora largely dark, with tips of femora contrastingly yellow; tibiae and tarsi yellow-brown to dark brown. Abdomen largely dark brown. Basal cone of ovipositor (♀) grey-dusted on dorsal surface on basal third to half.

Male postabdomen with 8th sternum fused with 6th tergum. Telomeres represented by densely setulose apical lobes of periandrium, more or less delimited by indistinct suture. Pregonites large, scarcely pigmented, extending ventrally (shielding base of aedeagus at rest). Aedeagus as Fig. 5-6, completely lacking spinules; basal sclerites long and narrow, not fused at base; sclerites of medial lobe fused distally, forming slender symmetrical U in ventral view, appearing distinctly recurved in lateral view; distal section with pair of strongly pigmented divergent terminal tubules (distiphallus) arising from unpigmented cylindrical area of sclerotization about ejaculatory duct. Ejaculatory apodeme as Fig. 7.

Puparium and third instar larva. – Mandibles with two alternating teeth; right mandible longer than left. Anterior spiracles with two short horns, with 9 - 10 bulbs in widely open ellipse; posterior spiracles on short conical projections, only slightly raised above level of last segment, with 12 - 17 bulbs in broad (nearly circular) ellipse. Puparia dark brown to black, 1.9 - 2.2 mm long, with prominent anal lobes.

Mine. – Larvae leaf-miners on *Aster sibiricus* L. Mine (Fig. 40) gradually widening linear-blotch, formed entirely on upper surface of leaf, appearing greenish white or greenish brown in reflected light when fresh; faeces deposited as discrete particles, conspicuous and mostly well separated in terminal blotchy part of mine; larvae leaving leaf through semicircular slit on upper surface before puparium formation.

Types. – Holotype ♂ from larva 31.viii.69 on *Aster sibiricus* L., near East shore of Lake Teslin (10 mile Creek; 60° 14′ N, 132° 55′ W), Yukon Territory, emerged 21.v.70, leg. G. C. D. Griffiths. 1 ♀ paratype from larva 18.vii.72 on *Aster sibiricus* L., near S end Kluane Lake (Slims Tundra at 4000 feet elevation), Yukon Territory, emerged 13.v.73, leg. G. C. D. Griffiths. 1 ♀ paratype from larva 27.viii.73 on *Aster sibiricus* L., Mount Cavell (6700 feet elevation), Jasper National Park, Alberta, emerged 30.iv.74, leg. G. C. D. Griffiths. 2 ♀♀ paratypes from larvae 29.viii.73 on *Aster sibiricus* L., near S end Medicine Lake (5300-5500 feet elevation), Jasper National Park, Alberta, emerged 29.iv.74, leg. G. C. D. Griffiths.

Remarks. – The name *despinosa* ("without spines") refers to the lack of spinules on the aedeagus. Apart from the characteristic structure of the aedeagus, this species is not very distinctive. It is probably univoltine. The host-plant, *Aster sibiricus* L., is widely distributed in the Old World, as well as in northwestern North America, but there is no information on what agromyzids it supports there.

Phytomyza solidaginivora Spencer 1969 (♂)

Phytomyza solidaginivora Spencer. Spencer, 1969: 274. Holotype ♂, Edmonton (Alberta), in K. A. Spencer's collection.

Adult. – Head with orbits not projecting above eye in lateral view; genae in middle about 0.25 times eye height; eyes with

only sparse fine pubescence. Frons at level of front ocellus about twice width of eye. Only one ors (posteriorly directed) present; only one strong (inwardly directed) ori (anterior ori short); orbital setulae few (3 on one side, 5 on the other), in one row. Peristomal margin with vibrissa and 3 upcurved peristomal setulae. Third antennal article rounded distally, with short fine pubescence.

3 + 1 dc; acr in about 5 rows; about 12 presutural ia; 5-7 postsutural ia; inner pa about half as long as outer pa.

Second cross-vein (m-m) absent. Costal ratio mg_2/mg_4 2.5. Wing length 2.2 mm.

Frons and orbits clear yellow, except dark ocellar plate; both vt on yellowish ground (dark colour of occiput and upper eye-margin scarcely extending onto vertex). Face completely yellow. Genae yellow. Occiput largely dark, but yellow-brown at sides ventrally. Antennae with first article yellowish, second and third articles dark brown to black. Palpi dark brown; labella yellow. Mesonotum dark centrally (strongly grey-dusted, scarcely shining), but with strongly contrasting broad whitish yellow side-bands extending from (almost completely whitish yellow) humeral calli to postalar calli and with whitish yellow patches also before corners of scutellum (posterior to inner pa); scutellum dark except for traces of yellow at basal corners; upper pleura extensively whitish yellow, but with dark anteroventral area on mesopleuron (pteropleuron with only weak traces of infuscation); propleuron largely dark (but area around spiracle whitish yellow); sternopleuron and hypopleuron largely dark, but pale dorsally along sutures. Wing base and squamae white, latter with brownish fringe. Coxae and trochanters dark; femora largely dark with contrasting yellow tips; tibiae and tarsi largely deep yellow.

Male postabdomen with telomeres represented by densely setulose apical lobes of periandrium, not delimited by suture. Pregonites large, with unpigmented ventral extensions (shielding base of aedeagus at rest). Aedeagus as Fig. 8-9, completely lacking spinules; basal sclerites long and narrow, narrowly joined by band of sclerotization on left side near base; sclerites of medial lobe fused distally, forming slender symmetrical V in ventral view, appearing strongly recurved in lateral view; distal section with pair of strongly pigmented, almost parallel (scarcely divergent) terminal tubules (distiphallus) arising from cylindrical area of sclerotization, pigmented ventrally only, about ejaculatory duct. Ejaculatory apodeme rather small (now lost).

Puparium and third instar larva. – Mandibles with two alternating teeth; right mandible longer than left. Anterior spiracles with two short horns, with about 10 bulbs in widely open ellipse; posterior spiracles on short conical projections, with 14 bulbs in rather narrow, irregular ellipse. Puparium brown, 1.9 mm long, with prominent anal lobes.

Mine. – Mine (Fig. 41) entirely linear, about 15 cm long, 2-3 mm wide terminally, formed entirely on upper surface of leaf, largely greenish brown in reflected light; faeces mostly deposited in beaded strips on alternate sides of mine; larva leaving leaf through semicircular slit on upper surface before puparium formation.

Material examined. – Holotype ♂ from larva 30.vi.66 on Astereae sp. (probably *Aster modestus* Lindl.), Edmonton (near University), Alberta, emerged 21.vii.66, leg. K. A. Spencer.

Remarks. – The holotype remains the only known specimen of this species. The identity of its host-plant (not in flower at the time of collection) requires confirmation. Spencer originally identified it as *Solidago* sp. However, the microscopical characters of the preserved leaf sample do not agree with either of the two species of *Solidago* common in the Edmonton area (*S. canadensis* L. and *S. gigantea* Ait.). The best agreement I can establish is with *Aster modestus* Lindl. However, this identification should be regarded as provisional until the breeding can be repeated.

Phytomyza phalangites new species

Adult. – Head with orbits not or only slightly projecting above eye in lateral view; genae in middle 0.25 - 0.35 times eye height; eyes with only sparse fine pubescence. Frons at level of front ocellus about twice width of eye. Ors directed posteriorly ori directed inwardly; posterior ors variably developed, in most cases about half as long as anterior ors, but ranging from almost fully as long to completely absent; only one strong (posterior) ori (with one or two pairs of short anterior ori in most specimens, but these absent in one male); orbital setulae more or less one-rowed. Peristomal margin with vibrissa and 3-6 upcurved peristomal setulae. Third antennal article rounded distally, with short fine pubescence.

3 + 1 dc; mesonotal setulae rather long; acr in 3-5 rows; 5-14 presutural ia; 6-10 postsutural ia; inner pa 0.25 to 0.5 as long as outer pa.

Second cross-vein (m-m) absent. Costal ratio mg_2/mg_4: ♂, 2.2 - 2.7 (mean 2.45); ♀, 2.4 - 2.9 (mean 2.65). Wing length: ♂, 2.3 - 2.7 mm (mean 2.45 mm); ♀, 2.4 - 2.9 mm (mean 2.7 mm).

Frons and orbits pale yellow, except dark centre of ocellar plate; dark colour of vertex in most specimens extending only to base of vte (vti on yellow ground), but in a few more or less to base of vti. Face largely or completely yellow, at most weakly infuscated in antennal pits. Genae pale yellow. Occiput largely dark, but yellow at sides ventrally. Antennae with first article yellow-brown, second article brown, third article black. Palpi black; labella yellow. Mesonotum dark centrally (strongly grey-dusted, scarcely shining), but extensively yellowish white on sides from humeral to postalar calli (brownish central patch of humeral calli broadly surrounded by yellow); small yellowish patches also before corners of scutellum (posterior to inner pa); scutellum dark; mesopleuron yellowish white on about dorsal quarter, otherwise dark; other pleura largely dark, but with whitish coloration along sutures. Wing base and squamae yellowish white, latter with dark fringe. Legs with coxae, trochanters and femora largely dark, with tips of femora contrastingly yellow; tibiae and tarsi yellow-brown to dark brown. Abdomen largely brown, narrowly yellowish along sides of terga and in some specimens narrowly along their hind margins. Basal cone of ovipositor (♀) grey-dusted on dorsal surface on basal third to half.

Male postabdomen with 8th sternum fused with 6th tergum. Telomeres represented by densely setulose apical lobes of

periandrium, more or less delimited by partial suture. Pregonites large, scarcely pigmented, extending ventrally (shielding base of aedeagus at rest). Aedeagus as Fig. 10-11; basal sclerites long and narrow, with dorsal area of fusion at about one-third of distance from their base; dense band of short spinules along dorsal margin of left basal sclerite, and patch of similar dorsally situated spinules on area of fusion of basal sclerites; sclerites of medial lobe fused distally, forming slender symmetrical V in ventral view, appearing distinctly recurved in lateral view; distal section with pair of strongly pigmented divergent terminal tubules (distiphallus) arising from largely unpigmented cylindrical area of sclerotization about ejaculatory duct. Ejaculatory bulb and apodeme as Fig. 12; bulb without or with only weakly differentiated lateral patches of pigmentation.

Puparium and third instar larva. – Mandibles with two alternating teeth; right mandible longer than left. Anterior spiracles with two short horns, with 12-15 irregularly distributed bulbs; posterior spiracles oval (nearly circular), on short conical projections, only slightly raised above level of last segment, with 19-28 bulbs in irregular, partly stellate pattern. Puparia dark brown to black, 1.8 - 2.0 mm long, with prominent anal lobes.

Mine. – Larvae leaf-miners on *Aster,* in larger leaves many feeding together to form large communal mine (Fig. 39); mine primary blotch (without initial linear channel), formed entirely on upper surface of leaf, appearing greenish white or greenish brown in reflected light when fresh; faeces deposited mostly in beaded strips, irregularly distributed throughout mine; larvae leaving leaf through semicircular slits, mostly on upper surface, before puparium formation.

Types. – Holotype ♂, 25 paratypes (10 ♂♂, 13 ♀♀, 2 sexually abnormal) from larvae 15.ix. 73 on *Aster ciliolatus* Lindl., Edmonton (north-facing slopes of river valley), Alberta, emerged 1-17.vi.74, leg. G. C. D. Griffiths. 1 ♂ paratype from larva 12.ix.73 on *Aster modestus* Lindl., Opal Sandhills (near Redwater), Alberta, emerged 8.vi.74, leg. G. C. D. Griffiths.

Remarks. – I name this species *phalangites* ("soldier in a phalanx"), because the larvae were in many cases found feeding more or less in a row in a communal mine. Note that the blotchy character of the mine is not a secondary result of communal feeding, since the mine on *Aster modestus* Lindl. (produced by a single larva) is also a blotch. The late appearance of the larvae is also noteworthy. I believe that this species is univoltine, since I did not find any mines earlier in the season.

Of the two paratypes listed as sexually abnormal, one has male-type external genitalia but with malformation of the aedeagus and, to a lesser degree, other structures, while the other lacks external genitalia entirely (terminal abdominal segments apparently absent). Significantly, both also show the same rare anomaly of the wing venation (partial fusion of the r_s branches). This suggests that their abnormality was caused by the same genetic factor, although the phenotypic effect on the development of the postabdomen was much more extreme in one case than in the other.

The characteristic apomorphous type of aedeagus described above and figured for *P. phalangites* is also shown, without or with only trivial (*P. astotinensis*) differences, by the following three taxa. These four taxa may be grouped together as the *P. phalangites* superspecies. It is surprising that these taxa, which are clearly differentiated in certain other respects, should have virtually identical aedeagi, since in most agromyzids the aedeagus is the most sensitive indicator of specific differentiation. But I think they must be regarded as full species, since they are partly sympatric. On external characters, they fall into two pairs: two species with extensively yellow mesonotal side-bands (*P. phalangites* and *P. astotinensis*) and two with dark mesonotum (*P. scopulina* and *P. peregrini*). The mines are readily separable in the one case where there is overlap of the host range (*P. scopulina* and *P. astotinensis* on *Solidago*).

Phytomyza astotinensis new species

Adult. – As described for *P. phalangites,* except as follows.

Genae in middle 0.15 - 0.2 times eye height. Posterior ors present in all specimens, 0.5 - 0.8 times as long as anterior ors; anterior ori about 0.5 times as long as posterior ori (also very short third pair of ori in two specimens). 4-5 upcurved peristomal setulae. Acr in 4-5 rows; 5-9 presutural ia; 5-7 postsutural ia. Costal ratio mg_2/mg_4 2.3 - 2.75 (mean 2.6). Wing length: ♂, 2.2-2.3 mm; ♀, 2.5 mm.

Pale coloration slightly more extensive, as follows. Both vt on yellow ground or vte more or less on boundary between dark and yellow ground (dark colour of occiput and upper eye-margin scarcely extending onto vertex). Mesopleuron yellowish white on about dorsal third; anterior parts of pteropleuron also largely yellowish white in most specimens. Tibiae and tarsi largely deep yellow. Abdomen with hind margins of terga, as well as their sides, contrastingly yellow in all specimens.

Distal section of aedeagus (Fig. 13) with pigmentation extending further basally onto the cylindrical area of sclerotization as pair of ventral stripes.

Puparium and third instar larva. – Similar to those of *P. phalangites,* but with, on average, fewer spiracular bulbs. Anterior spiracles with about 10 bulbs; posterior spiracles with 15-21 bulbs in broad oval ellipse, in some cases with stellate areas. Puparia 1.8 - 1.9 mm long.

Mine. – Larvae leaf-miners on *Solidago.* Mine (Fig. 42) entirely linear, 6-12 cm long, remaining narrow (about 1.5 mm wide) terminally, formed entirely on upper surface of leaf, appearing white or greenish white in reflected light when fresh; faeces deposited as fine particles, mostly forming short beaded strips; larvae leaving leaf through semicircular slit on upper surface before puparium formation.

Types. – Holotype ♂, 2 ♂♂ 3 ♀♀ paratypes from larvae 21.ix.71 on *Solidago gigantea* Ait., Elk Island National Park (near NE shore of Astotin Lake; 53° 41′ N, 112° 50′ W), Alberta, emerged 14-28.v.72, leg. G. C. D. Griffiths; 1 ♂ paratype from larva 7.viii.71 on *Solidago canadensis* L., same locality (near W shore of Astotin Lake), emerged 15.v.72, leg. G. C. D. Griffiths.

Remarks. – This species seems to be univoltine. Linear mines on *Solidago* in Central Alberta earlier in the season have proved to be caused by *P. solidaginophaga* Sehgal.

Phytomyza scopulina new species

Adult. – As described for *P. phalangites,* except as follows.

Genae in middle 0.2 - 0.35 times eye height. Posterior ors variably developed, in most cases about half as long as anterior ors, ranging from 0.2 times to fully as long (absent on one side in two specimens); one strong (posterior) ori and 1-2 pairs of short anterior ori. 2-4 upcurved peristomal setulae. Acr in 4-6 rows; 5-14 presutural ia; 4-9 postsutural ia. Costal ratio mg_2/mg_4 in specimens bred from *Erigeron* 2.4 - 2.7 (mean 2.55), in specimens bred from *Solidago* 2.1 - 2.65 (mean 2.35) (mean of all specimens 2.4). Wing length: ♂, 2.35 - 2.6 mm (mean 2.5 mm); ♀, 2.0 - 2.8 mm (mean 2.5 mm).

Colour much darker. Centre of frons and lunule orange-yellow, with ocellar plate and vertex contrastingly black (vte on dark ground; vti on boundary between dark and pale ground); orbits in most specimens ochreous to brownish along eye margins with fine whitish dusting (but clear yellow in a few). Face yellow at sides, infuscated to varying extent in antennal pits. Genae orange-yellow. Occiput black. Antennae with first article brown, second and third articles black. Palpi black; labella yellow. Thorax largely black, strongly grey-dusted (only weakly shining); mesonotum in most specimens with traces of paler (brownish) coloration only at corners of humeral calli, in a few also with upper part of sutural triangle brownish; seams of notopleural and mesopleural sutures whitish; wing base yellowish white; squamae yellowish white or greyish, with dark margin and fringe. Legs largely dark, with tips of front femora contrastingly yellowish; tips of other femora less contrasting, dull yellow to yellow-brown; tibiae and tarsi brown to dark brown. Abdomen largely dark brown. Basal cone of ovipositor (♀) grey-dusted on dorsal surface on basal third to half.

Male postabdomen and genitalia as described for *P. phalangites,* except that in most specimens the ejaculatory bulb bears conspicuous lateral patches of pigmentation.

Puparium and third instar larva. – Mandibles with two alternating teeth; right mandible longer than left. Anterior spiracles with two short horns, with 10-12 irregularly distributed bulbs; posterior spiracles on short conical projections, only slightly raised above level of last segment, with 13-18 bulbs in broad oval (nearly circular) ellipse. Puparia dark brown to black, 1.7 - 2.0 mm long, with anal lobes only weakly prominent.

Mine. – Larvae leaf-miners on *Erigeron* and *Solidago.* Mine (Fig. 44) gradually widening linear-blotch, formed entirely on upper surface of leaf, appearing greenish white or greenish brown in reflected light when fresh (on *Solidago* with areas of purplish discoloration often developing around mines); faeces deposited as discrete particles, conspicuous and mostly well separated in terminal part of mine; larvae leaving leaf through semicircular slit on upper surface before puparium formation.

Types. – Holotype ♂, 2 ♂♂ 3 ♀♀ paratypes from larvae 27-28.viii.73 on *Erigeron debilis* (Gray), Mount Cavell (on moraine and cliff ledges, 5900-6700 feet elevation; 52° 41′ N, 118° 3′ W), Jasper National Park, Alberta, emerged 30.ix.73 (1 ♀) and 25-26.iv.74, leg. G. C. D. Griffiths. 1 ♂ paratype from larva 30.viii.73 on *Erigeron glabellus* Nutt. subsp. *pubescens* (Hook.), 11 miles N Jasper (shaded rock outcrop at 3400-3500 feet), Jasper National Park, Alberta, emerged 26.iv.74, leg. G. C. D. Griffiths. 2 ♂♂ 2 ♀♀ paratypes from larvae 29.viii.73 on *Solidago multiradiata* Ait., near S end Medicine Lake (4900-5500 feet elevation), Jasper National Park, Alberta, emerged 26. iv-14.v.74, leg. G. C. D. Griffiths. 1 ♀ paratype from larva 21.viii.71 on *Solidago multiradiata* Ait., Whistlers Mountain (fellfield tundra at 7300-7800 feet elevation), Jasper National Park, Alberta, emerged 9.v.72, leg. G. C. D. Griffiths. 3 ♂♂ 5 ♀♀ paratypes from larvae 3-11.viii.70 on *Solidago multiradiata* Ait., Summit Lake Pass (4200-4500 feet elevation; Alaska Highway mile 392), British Columbia, emerged 7-13.v.71, leg. G. C. D.

Griffiths. 2 ♀♀ paratypes from larvae 26.vii.72 on *Solidago multiradiata* Ait., near S end Kluane Lake (canyon on North slope of Outpost Mountain at 3000 feet elevation), Yukon Territory, emerged 18.iv & 7.v.73, leg. D. E. Griffiths.

Remarks. – I name this species *scopulina* ("dwelling on cliffs"), since several of the collections were made from this habitat. It also occurs on alpine tundra and in montane forest (Summit Lake Pass and Medicine Lake collections). Besides the material listed above, I also refer to this species a small sample of larvae collected 11.viii.70 on *Erigeron humilis* Graham in Summit Lake Pass (4800-5000 feet elevation), from which only a pteromalid was obtained.

The occurrence of this species both on *Solidago* and on certain *Erigeron* species is surprising. Despite careful comparison I can find no difference between series bred from these hosts except for a small difference (doubtfully significant) in the mean costal ratio, as noted in the above description. I am of the opinion that only a single taxon is involved.

It is evident from the above records that *P. scopulina* is normally univoltine (only a single abnormally small female emerged in the same season) and distributed in the mountain cordillera of northwestern North America. It does not occur in the lowland boreal forest around Edmonton, despite the abundance of suitable host-plants.

Phytomyza peregrini new species

Adult. – As described for *P. phalangites,* except as follows.

Genae in middle 0.3 - 0.4 times eye height. Posterior ors variably developed, in most cases about half as long as anterior ors, ranging from 0.2 to 0.8 times as long; anterior ori 0.5 - 0.7 times as long as posterior ori (also very short third pair of ori in one male). 3-4 upcurved peristomal setulae. Acr in 4-6 rows; 6-12 presutural ia; 6-7 postsutural ia. Costal ratio mg_2/mg_4 2.0 - 2.3 (mean 2.2). Wing length: ♂, 2.3 - 2.5 mm (mean 2.4 mm); ♀, 2.6 - 2.8 mm.

Colour much darker (somewhat darker also than in *P. scopulina*). Centre of frons and lunule deep orange-yellow to orange-brown, with ocellar plate contrastingly black; vertex more or less dark as far as base of vti; orbits largely ochreous to brownish, with fine whitish dusting. Face entirely infuscated. Genae deep orange-yellow to orange-brown. Occiput black. Antennae with first article dark brown, second and third articles black. Palpi black; labella yellow. Thorax almost entirely black, strongly grey-dusted (only weakly shining); mesonotum with traces of paler (brownish) coloration only at corners of humeral calli; seams of notopleural and mesopleural sutures whitish; wing base yellowish white; squamae yellowish white or greyish, with dark margin and fringe. Legs almost entirely dark, with only tips of front femora contrastingly yellowish; tips of other femora at most yellow-brown (scarcely paler in some specimens); tibiae and tarsi dark brown. Abdomen largely dark brown. Basal cone of ovipositor (♀) grey-dusted on dorsal surface on basal third to half.

Male postabdomen and genitalia as described for *P. phalangites,* except for the presence of lateral patches of pigmentation (fairly conspicuous in most specimens) on the ejaculatory bulb.

Puparium and third instar larva. – Similar to those of *P. scopulina,* but with, on average, more numerous bulbs on posterior spiracles; posterior spiracles with 15-25 bulbs more or less in broad oval ellipse, in some cases with stellate areas. Puparia 1.8 - 2.0 mm long.

Mine. – Larvae leaf-miners on *Erigeron peregrinus* (Pursh). Mine (Fig. 45) more or less linear throughout, 5-6 cm long, 2-3 mm wide terminally, formed entirely on upper surface of leaf, appearing greenish white or greenish brown in reflected light when fresh; faeces deposited as discrete particles; larvae leaving leaf through semicircular slit on upper surface before puparium formation.

Types. – Holotype ♂, 4 ♂♂ 2 ♀♀ paratypes from larvae 15-19.viii.71 on *Erigeron peregrinus* (Pursh) subsp. *callianthemus* (Greene), near Mount Cavell Chalet (6200-6900 feet elevation; 52° 41′ N, 118° 3′ W), Jasper National Park, Alberta, emerged 7-10.v.72, leg. G. C. D. Griffiths.

Remarks. – The differences between this species and *P. scopulina* (lower costal ratio, darker colour, larva with more numerous bulbs on posterior spiracles) are relatively slight. But since they are shown consistently in my series from the same locality (Mount Cavell), I can only conclude that I have sampled genetically distinct populations.

I have also found empty mines similar to those of *P. peregrini* on the coastal subspecies *Erigeron peregrinus peregrinus* (Pursh) at Sitka (Alaska). An identification of their producer will not be possible until flies are obtained.

Phytomyza virgaureae Hering 1926

Phytomyza virgaureae Hering. Hering, 1926: 458. – 1927: 113. Hendel, 1935: 497. De Meijere, 1937: 236. Syntypes ♂ ♀, Rigi (Switzerland), in Zoologisches Museum, Humboldt Universität, Berlin.

Phytomyza sp. Hering, 1957: 165.

Phytomyza simmi Beiger. Beiger, 1959b: 1. – 1960: 107, 153. – 1972: 488. Holotype ♀, Ojców (Poland), in Zakład Zoologii Systematycznej UAM, Poznan. NEW SYNONYMY.

Adult. – Head with orbits not or only slightly projecting above eye in lateral view; genae in middle 0.2 - 0.3 times eye height; eyes with only sparse fine pubescence. Frons at level of front ocellus 1.5 - 2 times width of eye. Ors directed posteriorly, ori directed inwardly; posterior ors variably developed, ranging from 0.8 times anterior ors to completely absent; anterior ori 0.3 - 0.8 times posterior ori; orbital setulae one-rowed. Peristomal margin with vibrissa and 3-5 upcurved peristomal setulae. Third antennal article rounded distally, with short fine pubescence.

3 + 1 dc; acr in 4-6 rows; 5-12 presutural ia; 2-8 postsutural ia; inner pa 0.33 to 0.5 as long as outer pa.

Second cross-vein (m-m) absent. Costal ratio mg_2/mg_4 2.3 - 2.8 (mean 2.6). Wing length: ♂, 2.0 - 2.4 mm (mean 2.15 mm); ♀, 2.2 - 2.5 mm (mean 2.3 mm).

Frons whitish yellow to (more rarely) orange-yellow centrally, with ocellar plate and vertex contrastingly black (vte on dark ground; vti on boundary between dark and pale ground); orbits partly yellow, but distinctly infuscated (at least brownish) along eye margins and around bases of orbital setae. Face largely infuscated. Genae yellow. Occiput black. Antennae entirely black, or at most with first article yellow-brown (Stolberg specimen). Palpi black; labella yellow. Thorax almost entirely dark, strongly grey-dusted (only weakly shining); mesonotum with traces of pale coloration only at corners of humeral and postalar calli; mesopleuron with narrow whitish dorsal band along notopleural suture; seam of mesopleural suture whitish; wing base and squamae yellowish white, latter with dark fringe. Legs largely dark, with tips of femora contrastingly yellow; tibiae and tarsi largely brown to dark brown. Abdomen largely brown to dark brown. Basal cone of ovipositor (♀) grey-dusted on dorsal surface on basal third to half.

Male postabdomen with 8th sternum fused with 6th tergum. Telomeres represented by densely setulose apical lobes of periandrium, not delimited by suture. Pregonites large, scarcely pigmented, extending ventrally (shielding base of aedeagus at rest). Aedeagus as Fig. 14-15; basal sclerites long and narrow, separated at base, the right turned outwards apically; long band of 17-20 spinules (mostly in single row, but partly in two rows medially) on dorsal surface of basal section; sclerites of medial lobe fused distally, forming slender symmetrical V in ventral view, appearing only slightly recurved in lateral view; distal section with pair of divergent terminal tubules (distiphallus) arising from cylindrical area of sclerotization about ejaculatory duct, unpigmented distally but with base of cylindrical area distinctly pigmented. Ejaculatory apodeme as Fig. 16.

Figures of the male genitalia have already been given by Beiger (1972), but she does not show the full complement of spinules on the aedeagus.

Puparium and third instar larva. – Described by de Meijere (1937) and Beiger (1960) (as *P. simmi*). Mandibles with two alternating teeth; right mandible longer than left. Anterior spiracles with two short horns, with 9-14 bulbs in widely open ellipse; posterior spiracles on short conical projections, with 12-23 bulbs in rather narrow, partly open ellipse. Puparia brown to black, 1.7 - 2.2 mm long, with prominent anal lobes.

Mine. – Larvae leaf-miners on *Solidago* and *Bellis*. Mine entirely linear, 10-12 cm long, about 2 mm wide terminally, formed entirely on upper surface of leaf, white or greenish white in reflected light when fresh; faeces deposited entirely as discrete particles or partly forming short beaded strips; larvae leaving leaf through semicircular slit on lower surface before puparium formation.

Mines both on *Solidago* and *Bellis* have been figured by Beiger (1960) (in the latter case as of *P. simmi*).

Material examined. – Syntype ♂ from larva 19.vii.25 on *Solidago virgaurea virgaurea* L., Rigi, Switzerland, emerged 6.viii.25, leg. O. & M. Hering (no. 2751). 1 ♀ from larva on *Solidago virgaurea virgaurea* L., Alter Stolberg (Südharz), Germany, emerged 8.vii.27, leg. M. Hering (no. 3134). 1 ♀ from larva 31.vii.54 on *Solidago virgaurea virgaurea* L., Chilworth, Surrey, England, emerged 14.viii.54, leg. G. C. D. Griffiths. 1 ♀ from larva 17.ix.55 on *Solidago virgaurea virgaurea* L., Holmbury–St. Mary, Surrey, emerged 8.x.55, leg. G. C. D. Griffiths. 1 ♂ 3 ♀♀ from larvae 12.vi.65 on *Solidago virgaurea virgaurea* L., Poulavallan, Clare, Ireland, emerged 30.vi -2.vii.65, leg. G. C. D. Griffiths. 1 ♂ from larva 11.vi.65 on *Solidago virgaurea virgaurea* L., Black Head, Clare, Ireland, emerged 29.vi.65, leg. G. C. D. Griffiths.

1 ♂ 1 ♀ from larvae 17-19.vi.59 on *Bellis perennis* L., Ojców National Park, near Kraków, Poland, emerged 4-8.vii.59, leg. M. Beiger (paratypes of *P. simmi*); 1 ♀ from larva 20.vi.73, same plant and locality, emerged 5.vii.73, leg. M. Beiger. 1 ♂ from larva 27.viii.74 on *Bellis perennis* L., Dolina Kościeliska (1000 metres elevation), Tatry, Poland, emerged 10.ix.74, leg. M. Beiger.

1 ♀ from larva 19.v.66 on *Bellis perennis* L., Berlin (-Dahlem), Germany, emerged 4.vi.66, leg. E. M. Hering (no. 7494).

Other records. – This species is widespread in Northern and Central Europe. Other published records are summarized as follows. Except where otherwise stated, all records were based on specimens bred from, or mines found on, *Solidago virgaurea virgaurea* L.

Britain – Additional Irish records given by Griffiths (1968); records of *Phytomyza* mines on *Bellis perennis* L. given by Griffiths (1966: 792) and Spencer (1972: 108) are probably also attributable to this species.

Germany – Additional records given by Hering (1926), Voigt (1929), Buhr (1932, 1964) and Starke (1942); Buhr's (1932) records for Mecklenburg include records for cultivated host-plants (*Solidago canadensis* L., *S. rugosa* Mill. and *S. serotina* Ait.), as well as a record for *Bellis perennis* L. ("upper-surface linear mine of a still undescribed agromyzid", p. 65). Hering (Hering & Spencer, 1968: 335) has also reported this species from *Bellis perennis* L. and cultivated plants of *Bellis silvestris* Cyr. in Berlin.

Switzerland – Sheet in Hering's mine herbarium for Pfäfers (vi.25).

Corsica – Monte Rotondo (Buhr, 1941b).

Austria – Sheet in Hering's mine herbarium for Schiltenberg near Linz (5.vii.62).

Poland – Recorded by Hering (1928b), Karl (1936), Nowakowski (1954 and 1962: 152, the latter record for *Solidago virgaurea* L. subsp. *alpestris* (W. et K.) in the Tatry Mountains), and Beiger (1955, 1960, 1970, 1973); records of mines on *Bellis perennis* L. summarized by Beiger (1972) (as *P. simmi*).

Denmark – Bornholm (Buhr, 1932).

Norway – Vaage, 11.vii.53 (Rydén, 1955).

Sweden – Recorded by Rydén (1933, 1947, 1956) and Lundqvist (1949).

Finland – Records summarized by Frey (1946).

Russia – Sheet for Moscow (14.vi.56) in Hering's mine herbarium.

Remarks. – The distinction between the mines of this species and those of *P. solidaginis* in terms of faecal deposition given in Hering's (1937, 1957) keys is overstated, since the faeces may be partly deposited in beaded strips in some mines of this species (as already noted by Rydén, 1933). Consequently it is possible that there may have been some confusion between this species and *P. solidaginis* in the case of records of mines on *Solidago* from which flies were not bred. The distribution indicated by published records, as summarized above, should therefore be checked critically by future workers in the countries concerned.

Beiger (1959b, 1960) separated *P. simmi* from *P. virgaureae* on the basis of a series of minor differences, namely: somewhat smaller lunula, higher genae, longer pubescence of third antennal article, greater variation in number of postsutural intraalar setulae, greater length of basal cone of ovipositor, paler squamal margin and more extensively yellow posterior margins of abdominal terga. I cannot confirm these stated distinctions as consistently differentiating specimens bred from *Bellis* and *Solidago,* and therefore conclude that Beiger's name should be synonymized. There is also no difference in the male genitalia between specimens bred from both host groups.

Phytomyza solidaginophaga Sehgal 1971 (♂)

Phytomyza solidaginophaga Sehgal. Sehgal, 1971: 378. Holotype ♂, George Lake (Alberta), in Canadian National Collection, Ottawa.

Adult. – As described for *P. virgaureae,* except as follows.

Genae in middle about 0.3 times eye height. Posterior ors ranging from fully as long as anterior ors to completely absent. Acr irregularly distributed, in 2-4 rows; 7-10 presutural ia; 4-6 postsutural ia. Costal ratio mg_2/mg_4 2.1 - 2.5. Wing length 2.1 - 2.3 mm.

Head darker coloured. Centre of frons brownish anteriorly, becoming whitish yellow only posteriorly on either side of ocellar plate; orbits broadly infuscated (dark brown to black); genae brown.

Aedeagus (Fig. 17) with basal sclerites narrowly joined at base, the right not turned outwards apically; band of (15-20) spinules on dorsal surface of basal section shorter, ending further before apex of basal sclerites; distal section entirely unpigmented. Ejaculatory apodeme as Fig. 18.

The male genitalia have already been figured by Sehgal (1971).

Puparium and third instar larva. – Mandibles with two alternating teeth; right mandible longer than left. Anterior spiracles

with two short horns, with about 10 bulbs in widely open ellipse; posterior spiracles on short conical projections, only slightly raised above level of last segment, with 13-18 bulbs in broad oval (nearly circular) ellipse. Puparia black, 1.8 mm long, with prominent anal lobes.

Mine. – Larvae leaf-miners on *Solidago*. Mine (Fig. 43) entirely linear, 6-8 cm long, 1.5 - 2.5 mm wide terminally, formed entirely on upper surface of leaf, appearing greenish white or greenish brown in reflected light when fresh; faeces deposited as fine particles, partly forming short beaded strips; larvae leaving leaf through semicircular slit on upper surface before puparium formation.

Material examined. – 1 ♂ paratype from larva 7.vi.68 on *Solidago canadensis* L. (= *lepida* auctt.), George Lake Field Station (53° 57′ N, 114° 06′ W), Alberta, emerged 30.iv.69, leg. G. C. D. Griffiths. 1 ♂ from larva 13.vi.70 on *Solidago decumbens* Greene, Jasper National Park (near Jasper townsite; 3600 feet elevation), Alberta, emerged 2.v.71, leg. D. E. Griffiths.

Remarks. – This species is exclusively univoltine (unlike *P. virgaureae*), and its larvae appear earlier than those of any other *Solidago*-miner in Alberta.

Mines on *Solidago decumbens* Greene on Sheep Mountain (near S end Kluane Lake, Yukon Territory), which were already vacated on 13.vii.72, are probably also attributable to this species.

Phytomyza bellidina Hering 1935

Phytomyza bellidina Hering. Hendel, 1934: 360. Hering, 1935a: 9. –1967: 17. De Meijere, 1937: 214. Holotype ♂, Rovinj (Yugoslavia), in Zoologisches Museum, Humboldt Universität, Berlin.

Adult. – Head with orbits only narrowly projecting above eye in lateral view; genae in middle about 0.4 times eye height; eyes with only sparse fine pubescence. Frons at level of front ocellus 2 - 2.5 times width of eye. Only one ors (posteriorly directed) present; two or three pairs of inwardly directed ori (of which anteriormost very short if three); orbital setulae numerous, more or less two-rowed in part. Peristomal margin with vibrissa and 2-5 upcurved peristomal setulae. Third antennal article rounded distally, with short fine pubescence.

3 + 1 dc; acr in 3-5 rows anteriorly; 8-12 presutural ia; 3-6 postsutural ia; inner pa 0.33 to 0.5 as long as outer pa.

Second cross-vein (m-m) absent. Costal ratio mg_2/mg_4 2.1 - 2.75 (mean 2.4). Wing length: ♂, 1.85 - 2.2 mm; ♀, 2.5 - 2.55 mm.

Frons largely whitish yellow with ocellar plate and vertex contrastingly black (vte on dark ground; vti on boundary between dark and pale ground); orbits partly whitish yellow, but somewhat infuscated along eye margins posteriorly and around bases of orbital setae. Face whitish yellow at sides, distinctly infuscated in antennal pits. Genae whitish yellow. Occiput largely black, but brownish at sides ventrally. Antennae with first article yellow-brown to dark brown, second and third articles black. Palpi black; labella yellow. Mesonotum dark centrally (strongly grey-dusted, scarcely shining), but with humeral callus (except brownish central patch) and sutural triangle contrastingly yellowish white, and with small yellowish-white patches also on postalar callus and before corners of scutellum (posterior to inner pa); scutellum dark ; mesopleuron with narrow yellowish-white band along dorsal margin (notopleural suture), otherwise dark; seam of mesopleural suture whitish; other pleura almost entirely dark. Wing base and squamae whitish yellow, latter with dark fringe. Legs largely dark, with tips of femora contrastingly yellow; tibiae and tarsi largely dark brown. Abdomen largely dark brown. Basal cone of ovipositor (♀) grey-dusted on about basal half.

Male postabdomen with 8th sternum more or less fused with 6th tergum along partly distinct suture line. Telomeres represented by densely setulose apical lobes of periandrium, more or less delimited by partial suture. Pregonites large, scarcely pigmented, extending ventrally (shielding base of aedeagus at rest). Aedeagus as Fig. 19-20, completely lacking spinules; basal sclerites long and narrow, more or less straight, fused at base; sclerites of medial lobe fused distally, forming slender more or less symmetrical V in ventral view, appearing strongly recurved in lateral view; distal section relatively small, with pair of short transverse sclerites at base (near apices of basal sclerites) and pair of divergent pigmented terminal tubules (distiphallus) arising from unpigmented cylindrical area of sclerotization about ejaculatory duct. Ejaculatory apodeme as Fig. 21.

The aedeagus has previously been figured by Ann Spencer (in Hering, 1967).

Puparium and third instar larva. – Described by de Meijere (1937) and Hering (1967). Mandibles with two alternating teeth; right mandible longer than left. Anterior spiracles with two short horns, with 11-15 bulbs in widely open ellipse; posterior spiracles on short conical projections, only slightly raised above level of last segment, with 15-21 bulbs in rather narrow, partly open ellipse. Puparia dark brown, about 2 mm long, with anal lobes only weakly prominent.

Mine. – Larvae leaf-miners on *Bellis*. Mine described by Hering (1935a), and in greater detail with good figures by Hering (1967) as follows.

"Upper-, more rarely underside, blotches, which are very shallow and soon appear whitish, originate from a small, rapidly widened channel. The channels are so shallow that even in places where under and upperside mines overlap no approximate

transparency is achieved, as appears in other thus overlapping mines. Only rarely does one observe linear mines which are only strongly widening towards their end; such channels are found if the mine runs along the midrib in the direction of the base of the progressively narrowing leaf and is then ± joined again to the first channel as it runs back. Thus arises a mine of broadly linear appearance, whose origin is indicated by the double faecal trail. In such cases the faeces are deposited in very uniform small particles, which lie for a long stretch on one side of the channel before changing to the other and only gradually become larger and somewhat more widely separated. In the common blotch-mines which begin with a short linear channel, only in the latter do the small particles lie clearly separated and approximately in rows; in the later blotch they cohere in larger clumps, which are irregularly distributed in the blotch. Only in one case was a large interparenchymal blotch-mine observed, which neither appeared whitish on inspection from the upper nor from the lower side of the leaf; only in the proximity of the leaf margin were some strips of whitish appearance visible, where the larva had fed on the uppermost layer of parenchyma. In this mine too the faeces had been deposited in larger, widely separated clumps. The larva leaves the mine through a semicircular slit situated on the lower side of the leaf."

Material examined. – Holotype ♂, 1 ♂ paratype from larvae 21.iii.33 on *Bellis silvestris* (L.), Rovinj, Istria, Yugoslavia, emerged 12.x.33, leg. H. Buhr (no. 35). 1 ♂ from larva 5.iv.54 on *Bellis* sp., Ostia (near Rome), Italy, emerged 25.viii.54, leg. G. C. D. Griffiths. 2 ♀♀ from larvae 15-16.iii.53 on *Bellis silvestris* (L.), Sintra, Portugal, emerged 21 & 27.xi.53, leg. K. A. Spencer.

Remarks. – This species has been confirmed only from the Mediterranean area, where it appears in a spring and autumn generation (with aestivation in the puparium), as already noted by Hering (1967). The known distribution may be summarized as follows.

Yugoslavia –	Localities in Istria and Dalmatia where mines were found on *Bellis silvestris* (L.) have been listed by Buhr (1941b) and Hering (1967).
Italy –	Rome (see above).
Spain –	Algeciras, on *Bellis* sp. (Spencer, 1957).
Portugal –	Sintra (Spencer, 1954b).

Records for northern Europe remain doubtful. A mine similar to that of this species was once collected on *Bellis perennis* L. at Warsow (Mecklenburg) by H. Buhr (23.ix.31), but the identity of the producer was never established. This mine was treated as no. 396 under *Bellis* by Hering (1935c) and subsequently referred by him (incautiously in my opinion) to *P. bellidina.* The figure of the mine of *P. bellidina* given by Hering (1957: 13) is of this mine. His subsequent work on the leaf-miners of Hvar should be consulted for figures of undoubted mines of *P. bellidina.* Spencer (1956) provisionally recorded this species from London, England, but seems subsequently to have withdrawn the record (see also Spencer, 1972: 108).

Phytomyza hoppi Hering 1925

Phytomyza hoppi Hering. Hering, 1925: 134. – 1927: 111. Hendel, 1935: 416. Syntypes ♂ ♀, Pfäfers (Switzerland), in Zoologisches Museum, Humboldt Universität, Berlin.

Adult. – As described for *P. bellidina,* except as follows.

Genae in middle 0.3 - 0.4 times eye height. Frons at level of front ocellus about twice width of eye. Two ori, anterior 0.4 - 0.5 times posterior; orbital setulae one-rowed. 3-5 upcurved peristomal setulae. 6 presutural ia; 3-5 postsutural ia. Costal ratio mg_2/mg_4 2.3 - 2.5. Wing length: ♂, 2.1 - 2.2 mm; ♀, 2.2 mm.

Orbits entirely yellow. Face largely yellow, only slightly infuscated in antennal pits. Brownish central patch of humeral callus larger.

Aedeagus as Fig. 22; distal section relatively larger, with pigmented terminal tubules (distiphallus) rather slender. Ejaculatory apodeme (Fig. 23) larger, broadly fan-shaped.

Puparium and third instar larva. – Puparia blackish brown (Hering, 1928); structure not described.

Mine. – Larvae leaf-miners on *Aster bellidiastrum* (L.). Mine described by Hering (1925) as follows.

"The fly lays its eggs on the underside of the leaves of *Aster bellidiastrum* Scop. The emerging larva goes directly through the leaf to the upperside, where it forms a long linear mine. This is at first very small and several times sinuate; black faecal particles lie irregularly right on the sidewalls of the channel. Later this expands considerably; the individual sinuations now lie very closely upon one another, and the faecal particles are very large and sparse, lying at wide distances from one another. Finally in the thick part of the mine the channel proceeds more straight again; here are found particularly well expressed feeding tracks ("herring-boning"), and as a result of this the mine appears more green in transmitted light. The end of this part lies on the underside of the leaf; the larva leaves the mine through an underside semicircular slit to transform in

the earth into a shining black puparium, from which after a short time the fly emerged (from 11.vii.24 onwards)".

A figure of the mine has been given by Hering (1925, 1927, 1957).

Material examined. – Syntype ♂, 1 ♂ 1 ♀ paratypes from larvae 23.vi.24 on *Aster bellidiastrum* (L.), Pfäfers, Switzerland, emerged 11-12.vii.24, leg. W. Hopp (Hering no. 2509).

Remarks. – This species is distributed in the Alps and Carpathians, where it appears to be bivoltine. Besides the type locality in Switzerland, larvae were found in 1939 on plants of *Aster bellidiastrum* (L.) originating from Achensee in the Austrian Tirol (Buhr, 1941a), and there is a sheet of mines collected 17.x.50 on this same plant at Ettenhausen, Bavaria, in Hering's mine herbarium. Collections in the Tatry Mountains (Poland) have been made by Beiger (1959a) and Nowakowski (Griffiths, 1966: 835).

The record for Berlin Botanical Gardens (sheet in Hering's mine herbarium dated 17.v.25) was presumably the result of an introduction with transplanted plants, since the host-plant is not native to the northern lowlands of Germany.

Phytomyza japonica Sasakawa 1953

I have already discussed this Japanese species in Part VIII (Griffiths, 1974d: 302). It was originally described from *Kalimeris yomena* Kitam. (as "*Aster indicus* L.") and subsequently reported from *Bellis perennis* L., as well as from members of other groups of Compositae besides the Astereae.

Phytomyza ovimontis new species (♂)

Adult. – As described for *P. demissa* Spencer (Part VIII: 304), except as follows.

Posterior ors almost as long as anterior ors; two ori, anterior 0.6 - 0.8 times as long as posterior. 3 upcurved peristomal setulae. Acr in 4 rows anteriorly; 10 presutural ia; 8 postsutural ia; inner pa about 0.33 as long as outer pa. Costal ratio mg_2/mg_4 1.75. Wing length 2.35 mm.

Colour darker. Frons (including orbits) largely dark brown, not contrastingly paler than black ocellar plate and vertex. Genae brown. Wing base and squamae greyish, latter with black fringe.

Aedeagus as Fig. 24, with row of 19 spinules on left side of basal section; sclerites of medial lobe more uniformly curved (not sharply angled near base); trace of weakly pigmented sclerotization also on right side of distal section (but smaller than strip on left side).

Puparium and third instar larva. – Similar to those of *P. demissa* (posterior spiracles with 13-14 bulbs). Puparium dark brown, 2.0 mm long; anal lobes not prominent.

Mine. – Larvae leaf-miners on *Erigeron caespitosus* Nutt. Single available mine (Fig. 46) apparently primary blotch (without initial linear channel), formed largely on upper surface of leaf (where appearing greenish white in reflected light) but with terminal feeding on lower surface; faeces deposited as particles mostly in centre of mine; larva leaving leaf through semicircular slit on lower surface before puparium formation.

Type. – Holotype ♂ from larva 27.vii.72 on *Erigeron caespitosus* Nutt., near S end Kluane Lake (canyon on Sheep Mountain at 4000 feet elevation; 61° 2′ N, 138° 32′ W), Yukon Territory, emerged 9.v.73, leg. G. C. D. Griffiths.

Remarks. – The host-plant, *Erigeron caespitosus* Nutt., has a limited distribution on dry sites in Yukon and Alaska, disjunct from its main distribution in mountains and prairies far to the South. It is particularly common in the area of active loess deposition around the South end of Kluane Lake. The name *ovimontis* ("of Sheep Mountain") refers of course to the type locality.

Phytomyza pieninica Nowakowski 1963

Phytomyza pieninica Nowakowski. Nowakowski, 1963: 43. Holotype ♂, Pienin Mountains (Poland), in Instytut Zoologiczny, Polska Akademia Nauk, Warsaw.

This species was described by Nowakowski on the basis of material bred from initially linear, becoming blotchy terminally, mines in leaves of *Aster alpinus alpinus* L. collected on the summit of Sokolica (747 metres elevation) in the Pienin Mountains. There is nothing to add to the very detailed original description. Nowakowski interprets his species, no doubt correctly, as closely related to *Phytomyza conyzae* Hendel, the well-known European miner of Inuleae. However, he erred in postulating that *Phytomyza asteris* Hendel was also closely related (see below under *Chromatomyia*). In *P. pieninica,* as in *P. conyzae,* the puparium is formed inside the leaf, an apotypic habit here evolved independently (for instance, of *Chromatomyia* and the *Phytomyza robustella* group) within the *P. albiceps* group.

Phytomyza erigerophila Hering 1928

Phytomyza erigerophila Hering. Hering, 1927: 116. – 1928a: 174. De Meijere, 1928: 169. Hendel, 1935: 396. Syntypes 2 ♀♀, Berlin (Germany), in Zoologisches Museum, Humboldt Universität, Berlin.

Phytomyza asteribia Hering. Hering, 1935c: 81. De Meijere, 1937: 213. Syntypes ♂♀, Alter Stolberg (Germany), in Zoologisches Museum, Humboldt Universität, Berlin. NEW SYNONYMY.

Adult. – Head with orbits not or only narrowly projecting above eye in lateral view; genae in middle 0.2 - 0.35 times eye height; eyes with only sparse fine pubescence. Frons at level of front ocellus about twice width of eye. Only one ors (posteriorly directed) present; normally two ori (inwardly directed), anterior 0.4 - 0.7 times posterior (but in a few specimens also short third ori, see note on variation below); orbital setulae one-rowed. Peristomal margin with vibrissa and 3-5 upcurved peristomal setulae. Third antennal article somewhat quadrate distally (not evenly rounded), with short fine pubescence, relatively larger in relation to size of head (height 0.3 - 0.4 times eye height) than in most other species of *P. albiceps* group.

3 + 1 dc; acr in 2-4 rows anteriorly; 3-8 presutural ia; 1-5 postsutural ia; inner pa about 0.33 as long as outer pa.

Second cross-vein (m-m) absent. Costal ratio mg_2/mg_4 1.6 - 2.1 (means: ♂, 1.8; ♀, 1.85). Wing length: ♂, 1.4 - 1.8 mm (mean 1.7 mm); ♀, 1.55 - 1.85 mm (mean 1.8 mm).

Frons largely yellow to orange-yellow, with ocellar plate and vertex contrastingly black (vte on dark ground; vti on boundary between dark and pale ground); orbits largely or completely yellow, at most with fine whitish dusting along eye margins and becoming brownish posteriorly. Face orange-yellow at sides, with varying degrees of infuscation in antennal pits (in some specimens no more than ochreous). Genae yellow to orange-yellow. Occiput black. Antennae with first article yellow-brown to dark brown, second article brown to black, third article black. Palpi black: labella yellow. Thorax largely dark, strongly grey-dusted (only weakly shining), but mesonotum with conspicuous yellow patches at corners of humeral calli and on postalar calli; mesopleuron with narrow whitish dorsal band along notopleural suture; seam of mesopleural suture whitish; wing base and squamae yellowish white, latter with ochreous to brown fringe. Legs with coxae, trochanters and femora largely dark, with tips of femora contrastingly yellow; tibiae and tarsi largely deep yellow to yellow-brown, at most with middle of hind tibiae infuscated. Abdomen largely dark brown. Basal cone of ovipositor (♀) grey-dusted on dorsal surface on basal third to half.

Male postabdomen with 8th sternum fused with 6th tergum. Telomeres represented by densely setulose apical lobes of periandrium, not delimited by suture. Pregonites with unpigmented ventral extensions (shielding base of aedeagus at rest). Aedeagus as Fig. 25; left basal sclerite reduced, less than half as long as right basal sclerite, joined with latter by band of sclerotization near base; row of 12-15 conspicuous spinules along dorsal margin of right basal sclerite; medial lobe absent; distal section entirely membranous and unpigmented, held adpressed against dorsal side of basal section by genital pouch when at rest, containing single ejaculatory duct (with apical chamber, but apparently not bifid). Ejaculatory apodeme small (Fig. 26).

Puparium and third instar larva. – Described by de Meijere (1928*, 1937), in the latter work as *P. asteribia.* Mandibles with two alternating teeth; right mandible longer than left. Anterior spiracles with two very short horns, with 8-10 bulbs in widely open ellipse; posterior spiracles on short conical projections, only slightly raised above level of last segment, with 8-16 bulbs in broad oval ellipse (nearly circular in some specimens). Puparia brown to black, 1.4 - 1.75 mm long, with prominent anal lobes.

Mine. – Larvae leaf-miners on *Erigeron* and *Aster amellus* L. Mine (Fig. 47) basically linear, 3-5 cm long, 1.5 - 2 mm wide terminally, but in some cases (especially in smaller leaves) with secondarily blotchy areas; faeces deposited as fine particles, partly forming short beaded strips; most mines confined to upper surface of leaf (where appearing greenish white or greenish

* Note that de Meijere confused two of his figure captions; the figure of the posterior spiracles of *P. erigerophila,* intended to to be labelled as Fig. 23b, has been mislabelled 24a.

brown in reflected light when fresh), but a few partly on lower surface; larvae leaving leaf through semicircular slit, in most cases on upper surface, before puparium formation.

The mine has previously been figured by Hering (1955).

Material examined. – Syntype ♀ (labelled as ♂), 1 ♂ paratype from larvae 17.vi.26 on *Erigeron acris acris* L., Berlin (–Frohnau), Germany, emerged 5-6.vii.26, leg. O. & M. Hering (no. 2931). 1 ♂ from larva 24.v.66 on *Erigeron acris acris* L., Mühlhausen (Katzentreppen), Thuringia, Germany, emerged 6-9.vi.66, leg. H. Buhr (no. 2774). 1 ♂ from larva 25.vii.74 on *Erigeron acris acris* L., Graitschen (near Jena), Thuringia, Germany, emerged 6.ix.74, leg. K. H. Zoerner (no. 4124). 1 ♀ from larva 4.ix.66 on *Erigeron acris acris* L., Dobien (Wittenberg district), Germany (without emergence date), leg. K. H. Zoerner (no. 331).

1 ♂ from larva 8.vii.35 on *Aster amellus* L., Alter Stolberg (Südharz), Germany, emerged 23.vii.35, leg. M. Hering (no. 4314) (syntype of *P. asteribia*). 1 ♀ from larva 22.v.71 on *Aster amellus* L., Bad-Blankenburg, Thuringia, Germany, emerged 6-7.vi.71, leg. K. H. Zoerner (no. 3233). 1 ♂ from larva 6.vi.74 on *Aster amellus* L., Jena (Leutratal), Thuringia, Germany, emerged 8.ix.74, leg. K. H. Zoerner (no. 4113).

3 ♂♂ 3 ♀♀ from larvae 5.vi.73 on *Erigeron glabellus glabellus* Nutt., Scotford Sandhills (5 miles W Bruderheim), Alberta, emerged 22-24.vi.73, leg. G. C. D. Griffiths. 1 ♀ from larva 16.vi.71 on *Erigeron glabellus glabellus* Nutt., Elk Island National Park, Alberta, emerged 3.vii. 71, leg. G. C. D. Griffiths. 3 ♂♂ 2 ♀♀ from larvae 14.vii.75 on *Erigeron acris* L. subsp. *politus* E. Fries), Edmonton (Whitemud Creek), Alberta, emerged 29.vii-1.viii.75, leg. G. C. D. Griffiths.

2 ♂♂ 2 ♀♀ from larvae 30.viii.73 on *Erigeron glabellus* Nutt. subsp. *pubescens* (Hook.), 11 miles N Jasper (shaded rock outcrop at 3400-3500 feet elevation), Jasper National Park, Alberta, emerged 25-27.iv.74, leg. G. C. D. Griffiths.

Variation. – The above description is based on European and Central Albertan material, between which no significant differences have been detected. However, the series of four specimens from the Rocky Mountains (Jasper National Park) requires comment. These are significantly darker than the rest of the material (orbits extensively infuscated, ochreous to dark brown; only small yellow patches at corners of humeral and postalar calli; middle and hind tibiae largely infuscated), and three of them are significantly larger (wing length: ♂, 1.9 mm; ♀, 2.0 mm, 2.25 mm). The other male is an obvious dwarf (wing length 1.6 mm, costal ratio mg_2/mg_4 only 1.45), probably outside the normal range of variation. Most probably this series represents a distinct subspecies. It is perhaps possible that the differences are only seasonal, since the Jasper series is the only one from overwintered puparia, and for this reason I am making no nomenclatural proposal at this time. But I regard this as unlikely, since seasonal dimorphism has never been reported in adults of the *P. albiceps* group. The mines from which the Jasper series was bred were linear throughout and significantly longer (8-10 cm) than those from other areas.

I am unable to find any clear-cut distinction between material bred from *Aster amellus* L. in East Germany from that bred there from the typical host, *Erigeron acris* L. It is possibly of significance that all three specimens from *Aster* before me have three ori and less markedly enlarged third antennal articles (height only about 0.3 times eye height) than is the case in most specimens bred from *Erigeron.* But they are not outside the range of variation of the latter, as shown (for instance) by Zoerner's Dobien specimen. I therefore propose to synonymize *P. asteribia* with *P. erigerophila*, at least at the species level. A statistical analysis of more extensive material than presently available is desirable to clarify whether there are grounds for supposing that the flies on *Erigeron* and *Aster* constitute more or less distinct series of populations (ecological subspecies).

Other records. – Additional European records of this species are as follows.

Britain – Not confirmed, but a sample of empty mines which I collected 14.ix.61 on *Erigeron acris acris* L. at Oxwich (Gower Peninsula, Wales) may well belong to this species.

France – Bred from *Erigeron acris acris* L. near Grenoble (Spencer, in press).
Holland – Meijendel, on *Erigeron acris acris* L. (Hering, 1959).
Denmark – Localities for mines on *Erigeron* given by Sønderup (1949).
Norway – Records given by Spencer (in press).
Finland – Probably some of the mines on *Erigeron* recorded from various localities by Linnaniemi (1913) were produced by this species, although no confirmed adults are yet available. However, Linnaniemi indicated that he did not think all his mines identical.
Germany – Additional localities for mines on *Erigeron acris acris* L. have been given by Buhr (1932), Hering (1955) and Zoerner (1970). Buhr (1941a) records the mines in Rostock Botanical Gardens on *Erigeron glaucus* Ker-Gawl, *E. grandiflorus* Hook. and its var. *elatior* Gray, *E. neglectus* Kern., *E. polymorphus* Scop. and *E. uniflorus* L. Records for mines on *Erigeron canadensis* L. from localities in Mecklenburg are given by Buhr (1954), and there is also a mine on this plant from the Berlin Botanical Garden in Hering's mine herbarium.
Poland – Recorded on *Erigeron acris acris* L. from Krosno (Crossen an Oder) by Hering (1932) and from the Dziwnów Peninsula by Nowakowski (1954).
Czechoslovakia – Localities for mines on *Erigeron acris acris* L. given by Skala & Zavřel (1945) and Zavřel (1956), and for mines on *Aster amellus* L. by Skala & Zavřel (1945); also sheets of *Aster amellus* L. for Kroměříž and Strabišov in Hering's mine herbarium.
Corsica – Recorded on *Erigeron canadensis* L. at Corté and Piana by Buhr (1941b).
Bulgaria – Dschabokrek, on *Erigeron canadensis* L. (Buhr, 1941b).

Remarks. – The supposed male syntype of this species is in fact a female; so there are two female syntypes.

This species is evidently multivoltine throughout its range, and the early feeding of the first-generation larvae is noteworthy.

Phytomyza solidaginis Hendel 1920

Phytomyza solidaginis Hendel. Hendel, 1920: 159. – 1935: 479. De Meijere, 1926: 292. – 1928: 174. – 1938: 93. Hering, 1927: 112. Lectotype ♀ by present designation, Vienna (Austria), in Naturhistorisches Museum, Vienna.

Adult. – As described for *P. erigerophila,* except as follows.

Normally two ori, anterior 0.3 - 0.8 times posterior (but in one male also short third ori on one side). Third antennal article relatively less enlarged (height about 0.3 times eye height), rounded to subquadrate apically. Acr in 3-5 rows anteriorly; 6-13 presutural ia; 2-4 postsutural ia. Costal ratio mg_2/mg_4 2.2 - 2.7 (mean 2.4). Wing length: ♂, 1.9 mm; ♀, 1.9 - 2.2 mm (mean 2.0 mm).

Colour paler. Vertex ochreous yellow to brownish, not contrastingly darker than yellow frons (both vt thus on yellowish or brownish ground); orbits completely yellow. Face not or only weakly infuscated in antennal pits. Genae clear yellow. Occiput largely dark, but becoming yellow on sides ventrally. Antennae with first article yellow-brown, second article brown to dark brown, third article dark brown to black. Palpi yellow-brown to brown. Humeral callus of mesonotum largely yellow with brownish centre patch (and in some specimens sutural triangle more or less brownish). Tibiae and tarsi largely yellow in all specimens (at most with hind tibiae somewhat infuscated). Abdomen largely brown to dark brown.

Aedeagus as Fig. 27; reduced left basal sclerite with group of 6-7 small spinules along dorsal margin at apex, not joined basally with right basal sclerite; row of 20-26 spinules along dorsal margin of only partially pigmented right basal sclerite. Ejaculatory apodeme larger (Fig. 28).

Puparium and third instar larva. – Described by de Meijere (1926, 1928, 1938). Mandibles with two alternating teeth; right mandible longer than left. Anterior spiracles with two short horns, with 9-11 bulbs in widely open ellipse; posterior spiracles on short conical projections, with 11-17 bulbs in narrow, partly open ellipse. Puparia brown to black, 1.65 - 1.75 mm long, with prominent anal lobes.

Mine. – Larvae leaf-miners on *Solidago.* Mine entirely linear, 6-9 cm long, 1.5 - 2 mm wide terminally, formed entirely on upper surface of leaf, greenish white in reflected light when fresh (but later in many cases becoming discoloured reddish violet or rusty yellow); faeces deposited as fine particles, mostly forming beaded strips; larvae leaving leaf through semicircular slit, in most cases on upper surface, before puparium formation.

The mine has been figured by Hering (1927, 1957).

Material examined. – Lectotype ♀ from larva on *Solidago virgaurea virgaurea* L., Hütteldorf

(near Vienna), Austria, emerged 15.vi, leg. F. Hendel. 1 ♂ (? syntype) from larva on *Solidago virgaurea* L. (without locality label), emerged 23.vi.19, leg. F. Hendel. 1 ♀ (? syntype) from larva on *Solidago virgaurea virgaurea* L., Weidling (near Vienna), Austria, emerged 2.viii. leg. F. Hendel. 1 ♀ (? syntype), Wienerwald, Austria, leg. P. Löw. 1 ♂ from larva vi.31 on *Solidago virgaurea virgaurea* L., Berlin (-Finkenkrug), Germany, emerged 30.vi.31, leg. M. Hering (no. 3795). 1 ♀ from larva 13.vi.66 on *Solidago virgaurea virgaurea* L., Mühlhausen (Stadtwald), Thuringia, Germany (without emergence date), leg. H. Buhr (no. 2857). 1 ♀ from larva 29.v.67 on *Solidago virgaurea virgaurea* L., Jena (Leutratal), Thuringia, Germany, emerged 15.vi.67, leg. H. Buhr (no. 3329). 1 ♀ from larva 13.vi.70 on *Solidago virgaurea virgaurea* L., Thale (Harz), Germany, emerged 28.vi.70, leg. K. H. Zoerner (no. 2381). 1 ♀ from larva 27.ix.53 on *Solidago virgaurea virgaurea* L., Darenth Wood, Kent, England, emerged 11.v.54, leg. G. C. D. Griffiths. 1 ♀ from larva on *Solidago virgaurea virgaurea* L., Hälsingborg, Skåne, Sweden (without dates), leg. N. S. Rydén (type of form *hendeli* Bryk).

Other records. – This species is widespread in Central Europe. Other published records are summarized as follows. Except where otherwise stated, all records are based on specimens bred from, or mines found on, *Solidago virgaurea* L.

Britain – Confirmed only for Darenth (Kent). Since flies bred from *Solidago* in other areas have so far all proved referable to *P. virgaureae*, Spencer's (1954a) record for Derbyshire remains doubtful.
Spain – Montserrat, 23.vi.33 (Hering, 1935b).
Belgium – Forêt de Meerdael (Collart, 1942).
Germany – Additional records given by Voigt (1929), Buhr (1932, 1964) and Hering (1955). Buhr (1932, 1941a, 1954) also gives records for cultivated hosts (*Solidago canadensis* L., *S. radula* Nutt., *S. rugosa* Mill., *S. serotina* Ait. and *S. shortii* Torr. et Gray) in Mecklenburg.
Switzerland – Sheet for Pontresina (3.viii.64) in Hering's mine herbarium.
Austria – Also sheets for Haselbachgraben and Hinterstoder in Hering's mine herbarium.
Italy – Alto Adige (Hartig, 1939).
Czechoslovakia – Recorded by Starý (1930), Kvíčala (1938), Zavřel (1953, 1960), Skala & Zavřel (1945) and Seidel (1957).
Roumania – Herculesbad, Banat (Hering, 1924).
Bulgaria – Rila Mountains (Buhr, 1941b).
Poland – Beiger (1973) has listed the numerous Polish records up to that date. Additional records are given by Michalska (1973) and Michna (1975).
Norway – Records given by Spencer (in press).
Sweden – Recorded by Rydén (1926, 1933, 1934, 1937, 1951, 1952) and Lundqvist (1949).
Finland – Linnaniemi's (1913: 93) records have been generally assumed to refer to this species, but confirmation by breeding is needed.
Russia – Moscow region (Rohdendorf, 1960).
Ukraine – Middle Dnieper (Puchkova, 1961).

Remarks. – This species is, as far as known, confined to *Solidago.* Hendel's (1935) listing of *Aster amellus* L. as a host was doubtless due to confusion with *P. erigerophila.* There is a possibility of some confusion in the records between mines of this species and those of *P. virgaureae,* as already mentioned in my remarks on the latter. The distribution indicated by the published records, as summarized above, should therefore be checked critically by future workers in the countries concerned.

Hendel's (1920) original description was based on three specimens, which thus constitute syntypes. However there are more than three specimens in Hendel's collection, and the only specimen which can confidently be assumed to be one of the original three is a female labelled "Typus" by Hendel. This is now formally designated as lectotype.

Bryk (1929) has described as "form *hendeli*" a female bred by Rydén in which the costa extends to vein m_{1+2}, not merely to r_{4+5} as normally in *Phytomyza.* In other respects the specimen (now in Berlin) seems normal. Bryk's name, being clearly intended to denote an aberration, does not enter species-group nomenclature in the sense of the 1961 International Code of Zoological Nomenclature.

It is clear that Nowakowski (1962: 105) was correct in interpreting *P. erigerophila* Hering and *P. solidaginis* Hendel as sister-species ("siblings"), as evidenced by the striking synapomorphies in the structure of the aedeagus (left basal sclerite reduced; medial lobe absent; distal section membranous).

(b) *Chromatomyia* Hardy

The definition of *Chromatomyia* has been explained in Part V (Griffiths, 1974a).

The known *Chromatomyia* miners of Astereae belong to two groups. First, the *C. syngenesiae* group, for which I have presented updated keys in Part VII (Griffiths, 1974c). And, secondly, the *C. erigerontophaga* group, so far known only from North America, which is characterized by unusually complex sclerotization of the aedeagus. This latter group may be recommended as study material to anyone wishing to investigate the structure of the aedeagus in *Chromatomyia,* since the complete course of the ejaculatory duct can be determined without difficulty under the dissecting microscope.

Chromatomyia asteris (Hendel 1934)

Phytomyza sp. De Meijere, 1926: 299.
"*Phytomyza tenella* Meigen". Hering, 1927: 130 (in part). De Meijere, 1928: 176. – 1934: 287.
Phytomyza asteris Hendel. Hendel, 1934: 352. Spencer, 1972: 87. Holotype ♂, Magdeburg (Germany), in Naturhistorisches Museum, Vienna.
Chromatomyia asteris (Hendel). Griffiths, 1974a: 37. – 1974c: 217.

Adult. – Conforming with my general description of the *C. syngenesiae* group (Griffiths, 1967:2), except as otherwise stated.

Orbits rather broad, distinctly projecting above eye in lateral view; anterior ori very short or absent in most specimens (but half as long as posterior ori on one side in one male); orbital setulae in 1-2 rows (partly 2-rowed in some specimens). Pubescence of third antennal article short; arista with thickened basal section short, less than 0.33 of arista length (not angularly delimited). 4-10 acr present in more or less 2 rows; 2-4 presutural ia; 1-4 postsutural ia. Costal ratio mg_2/mg_4 1.4 - 1.9 (means: ♂, 1.55; ♀, 1.75). Wing length: ♂, 1.6 - 2.2 mm (mean 1.95 mm); ♀, 2.1 - 2.4 mm (mean 2.3 mm). Length of hind metatarsus: ♂, 0.2 - 0.25 mm (mean 0.225 mm); ♀, 0.275 mm.

Frons (including orbits) entirely yellow except dark ocellar plate; dark colour of occiput not or only narrowly (posterior to base of vte) extending onto vertex and posterior eye-margin; face yellow at sides, infuscated to varying degree in antennal pits; antennae with first and second articles clear yellow (strongly contrasting with black third article); palpi orange-yellow to yellow-brown. Front trochanters and tips of front coxae yellow to ochreous yellow. Costa yellow to yellow-brown. Basal cone of ovipositor (♀) grey-dusted on basal half to two-thirds.

Aedeagus as Fig. 29; basal sclerites becoming broad and obscurely defined distally; dorsal lobe (Überdachung) uncleft, entirely unpigmented or with traces of pigmentation only basally on centre-line (mediane Chitinversteifung), without clearly differentiated supporting sclerites; distal tubule bent upwards at single point before about apical third (compare *C. syngenesiae* Hardy, *C. farfarella* (Hendel) and *C. kluanensis* Griffiths); sac below distal tubule (Halbballon) not papillose, relatively small, with hind margins unsclerotized. Ejaculatory apodeme as Fig. 30.

The aedeagus has previously been figured by Spencer (1972). German words in the above description refer to von Tschirnhaus' (1969) detailed discussion of the aedeagus of the *C. syngenesiae* group.

Puparium and third instar larva. – Described by de Meijere (1926, 1928). Differing from those of most other species of the *C. syngenesiae* group (except *C. kluanensis* Griffiths, see Part VII) in respect of the larger spiracles with more numerous bulbs. Anterior spiracles knob-shaped, with 18-22 irregularly distributed bulbs; posterior spiracles on short conical projections, knob-shaped, with 24-33 bulbs in irregular stellate pattern. Puparia white, 1.9 - 2.4 mm long.

Mine. – Larvae leaf-miners on *Aster tripolium* L. Mine entirely linear, remaining narrow terminally (1-1.5 mm wide), in most cases much convoluted; faeces deposited as discrete particles, mostly separated by over 1 mm in terminal part of mine; mine on upper or lower surface of leaf, rather inconspicuous (due to fleshy nature of host-plant's leaves), with channels near surface greenish white in reflected light when fresh. Puparium with its ventral surface adjacent to lower surface of leaf, with its anterior spiracles projecting ventrally through epidermis.

Material examined. – Holotype ♂ (in Hendel collection), 2 ♀♀ (in Berlin) from larvae vii.20 on *Aster tripolium* L., Sülldorf (near Magdeburg), Germany, emerged 8.viii.20, leg. M. Hering (no. 1584). 2 ♂♂ from larvae and puparia 18.vii.71 on *Aster tripolium* L., Hecklingen (Magdeburg district), Germany, emerged 31.vii - 2.viii.71, leg. K. H. Zoerner (no. 3434); 1 ♀ from puparium

16.vii.72, same plant and locality, emerged 19-23.vii.72, leg. K. H. Zoerner (no. 3698). 7 ♂♂ (caught), 20-30.v.68, Dagebüll/Nordsee, Germany, leg. M. von Tschirnhaus. 1 ♂ (caught), 27. vi.54, Faversham, Kent, England, leg. G. C. D. Griffiths. 2 ♀♀ from puparia 12.ix.61 on *Aster tripolium* L., Llanrhidian, Gower Peninsula, Wales, emerged 19.ix.61, leg. G. C. D. Griffiths; also preparation of larva from this sample. Preparations of two larvae from Poulnaclogh Bay, Clare, Ireland (4.ix.66) and one from Pagham, Sussex, England (10.vi.62), all from *Aster tripolium* L.

Distribution. – This species is found mainly in coastal salt marshes.

Additional Irish records have been given by Griffiths (1968) and Spencer (1972). Since these include localities on both the East and West coasts, it seems likely that the fly will be found all round the coast with its host-plant. The same is probably the case for England and Wales (localities on the East, South and West coasts listed above), but we do not known how far North the range extends.

On the continent of Europe the presence of this species has been confirmed along the coasts of the North Sea and Baltic from Ostend in Belgium (Collart, 1942), the Zuiderzee in Holland (de Meijere, 1926 & 1934), Copenhagen (de Meijere, 1928) and Falster (Sønderup, 1949) in Denmark, Schleswig-Holstein (Dagebüll, as recorded above), as far East as Mecklenburg (localties given by Buhr, 1941a and Zoerner, 1970).

The only inland localities so far known are in the Magdeburg district of East Germany, as recorded above.

Remarks. – The relationships of this species have long been misinterpreted. Hering (1927) confused it with *Phytomyza tenella* Meigen, a seed-feeder on Scrophulariaceae which is not at all closely related. Nowakowski (1963) incorrectly assumed that it was the sister-species of his *Phytomyza pieninica,* which is a true *Phytomyza* belonging to the *P. albiceps* group (see above). The structure of the aedeagus (Fig. 29) indicates that *asteris* in fact belongs to the *Chromatomyia syngenesiae* group. I have presented a revised key to the World species of this group in Part VII (Griffiths, 1974c).

Hendel's (1934) statement that Copenhagen was the type-locality of this species seems to have been a lapsus. While Hering had indeed collected it at Copenhagen, the holotype (the sole specimen in Hendel's collection) is from Hering's Magdeburg series.

Chromatomyia horticola (Goureau 1851)

This polyphagous member of the *C. syngenesiae* group has been recorded from *Aster* and *Erigeron* in the Old World (Griffiths, 1967). See that paper for further information, including synonymy. It is noteworthy that *Bellis* and *Solidago* are virtually the only Compositae which are not attacked by polyphagous species of the *C. syngenesiae* group in Europe.

Chromatomyia erigerontophaga (Spencer 1969)

Phytomyza erigerontophaga Spencer. Spencer, 1969: 239 (in part). Holotype ♂, Peary Land (Greenland), in Universitetets Zoologiske Museum, Copenhagen.
Chromatomyia erigerontophaga (Spencer). Griffiths, 1974a: 37.

Adult. – Head with rather broad orbits, in lateral view distinctly projecting above eye anteriorly; genae in middle 0.4 - 0.6 times eye height; eyes with only sparse fine pubescence. Frons at level of front ocellus about twice width of eye; orbits occupying 0.4 - 0.5 times frons width. Two ors, of about equal length, posteriorly directed; only one strong (inwardly directed) ori (anterior ori short or absent); orbital setulae in 1-2 rows. Peristomal margin with vibrissa and 3-5 upcurved peristomal setulae. Third antennal article somewhat enlarged (height 0.4 times eye height), with short fine pubescence, more or less angled at upper distal corner (uniformly rounded only ventrally).

3 + 1 dc; acr few (5-11, mostly anteriorly situated in more or less two irregular rows); 3-6 presutural ia; 1-2 postsutural ia;

inner pa short, less than 0.25 as long as outer pa.

Second cross-vein (m-m) absent. Costal ratio mg_2/mg_4 1.0 - 1.3 (means: ♂, 1.1; ♀, 1.15). Wing length: ♂, 2.1 - 2.2 mm (mean 2.15 mm); ♀, 2.1 - 2.45 mm (mean 2.3 mm).

Colour almost entirely dark. Frons dark brown at least anteriorly, at most becoming partly brownish or ochreous posteriorly (especially on either side of ocellar plate). Genae dark brown. Labella yellow. Thorax densely grey-dusted (scarcely shining) over black ground-colour; seams of notopleural and mesopleural sutures ochreous yellow or greyish; wing base ochreous to yellow-brown; squamae greyish, with dark margin and fringe. Legs largely black, but with tips of all femora contrastingly bright yellow. Basal cone of ovipositor (♀) grey-dusted on dorsal surface on basal third to half.

Male postabdomen with 8th sternum apparently absent (no trace of line of fusion with 6th tergum). Telomeres not delimited from periandrium, indicated by dense group of fine setulae. Pregonites not extending ventrally. Aedeagus as Fig. 31-33; basal sclerites rather long; below distal part of basal section arise pair of slender divergent sclerites with spiniform tips (? sclerites of medial lobe), these asymmetrically developed (the left extending further distally than the right); dorsal lobe with large central excavation, its sclerotization (supporting sclerite complex) consisting of broad basal plate (in some specimens rather weakly pigmented) confluent with sclerite on centre-line through whose base the ejaculatory duct passes; pair of small lateral sclerites at junction of basal and distal sections; distal section with pair of conspicuous convergent sclerites (strongly upcurved in lateral view) fused distally below gonopore; transverse pigmentation of rim of distal section beyond gonopore weak or absent (contrast *C. thermarum* n. sp.); ejaculatory duct distinctly pigmented within basal section, but virtually unpigmented distal to base of supporting sclerite complex. Ejaculatory apodeme very small, but strongly pigmented (Fig. 34).

Puparium and third instar larva. – Mandibles with two alternating teeth; right mandible longer than left. Spiracles small and knob-shaped, with bulbs distributed more or less in circle; anterior spiracles with 7-8 bulbs; posterior spiracles on short conical projections, with 9 bulbs. Puparia yellowish white, 2.4 - 2.6 mm long.

Mine. – Larvae leaf-miners on *Erigeron,* entering more than one leaf before completing development. Mine (terminal part as Fig. 48) mainly in petiole and basal part of leaf, on upper or lower surface, appearing whitish or greenish white in reflected light when fresh; faeces deposited as discrete particles. Puparium with its ventral surface adjacent to (upper or lower) surface of leaf, with its anterior spiracles projecting ventrally through epidermis, in most cases formed in petiole or near base of leaf.

Material examined. – 10 ♂♂ 9 ♀♀ paratypes from puparia 12.vii.66 on *Erigeron compositus* Pursh, Nedre Midsommer Sö, Peary Land, Greenland, emerged 12-14.vii.66, leg. J. E. H. Martin; also two puparia and some mined leaves from this sample preserved in alcohol. 2 ♀♀ caught 16. vii.66 & 15.vii.67 on flowers of *Erigeron compositus* Pursh, Lake Hazen Camp (81° 49′ N, 71° 18′ W), Ellesmere Island, Canada, leg. P. G. Kevan; 2 ♀♀ (caught), 19.vi & 30.vii.62, same locality, leg. J. F. McAlpine and R. B. Madge. 1 ♂ paratype from puparium on *Erigeron eriocephalus* J. Vahl, Frobisher Bay, Baffin Island, Canada, emerged 6.vii.65, leg. D. Dittrich. 1 ♂ paratype (caught), 29.vii.61, Cape Thompson, Alaska, leg. B. S. Heming. Also leaf-mines with puparia on *Erigeron eriocephalus* J. Vahl from Frobisher Bay, Baffin Island (3 & 13.vii.48, leg. Senn & Calder) and *Erigeron humilis* Graham from Crater Lake (58° 02′ N, 64° 02′ W), Labrador (24.vii.54, leg. Gillett).

Remarks. – This species has figured in studies of pollination ecology on Ellesmere Island by Kevan (1972a, 1972b, 1973), where the adults have been regularly found on the flowers of the larval host-plant, *Erigeron compositus* Pursh. This is surprising, since most Agromyzidae show no interest in flowers except for the few which seek them as oviposition sites. According to Kevan's observations, this species is the only regular visitor of its host-plant's flowers and compensates for the damage it causes as a larva by pollinating the host. Whether the flies visit the flowers for feeding or for some other purpose has not been established.

The above description is based on the material from the Eastern Arctic. Spencer's (1969) original description states a wider range of variation, since he included (and designated as paratypes) two specimens (♂♀) from Cape Thompson, Alaska (caught 29.vii.61 by B. S. Heming). The identity of these requires clarification. The male (on whose aedeagus Spencer's Figs. 427-428 are based) agrees well with material from the Eastern Arctic except that it has two strong ori of about equal length. But the female has a costal ratio mg_2/mg_4 (1.6) well outside the range of Eastern Arctic material, in this respect resembling the new species described below as *C. thermarum.* However, it clearly does not belong to the latter species, as its head coloration is dark as in true *C. erigerontophaga.* I am inclined to assume that the male from Cape Thompson has been correctly included in *C. erigerontophaga,* while the female represents a closely related

undescribed species. More material from the Western Arctic is needed to clarify this question. Note in comparing my figures of the aedeagus with those of Spencer (1969) that his lateral view (Fig. 427) has been printed upside down in relation to his other figures.

Mines of the type described for *C. erigerontophaga* also occur at high elevation in the Rocky Mountains (5900-6700 feet on Mount Cavell) in basal rosettes of *Erigeron debilis* (Gray). The identity of their producer has not yet been established. There must be two generations a year, as only empty puparia were found on 27.viii.73.

Chromatomyia thermarum new species

Adult. – As described for *C. erigerontophaga*, except as follows.

Genae in middle 0.3 - 0.4 times eye height. Height of third antennal article 0.4 - 0.45 times eye height. Acr very variably developed (5-18, in 2-3 rows anteriorly); 2-9 presutural ia; 0-2 postsutural ia. Costal ratio mg_2/mg_4 1.5 - 1.9 (mean 1.65). Wing length: ♂, 2.05 - 2.45 mm (mean 2.3 mm); ♀, 2.25 - 2.6 mm (mean 2.4 mm).

Colour somewhat paler. Centre of frons ochreous yellow to orange-brown anteriorly, becoming more or less clear yellow posteriorly (especially on either side of ocellar plate). Genae yellow-brown to brown. Seams of notopleural and mesopleural sutures whitish yellow to ochreous yellow; wing base whitish yellow or yellow; squamae yellowish white with ochreous to dark fringe. Basal cone of ovipositor (♀) grey-dusted on basal half to two-thirds.

Distal section of aedeagus (Fig. 35-36) with conspicuously pigmented lateral pegs at base of convergent sclerites, and with transverse pigmentation of rim beyond gonopore conspicuously developed.

Puparium and third instar larva. – Similar to those of *C. erigerontophaga*. Anterior spiracles knob-shaped, with 9-12 irregularly distributed bulbs; posterior spiracles also knob-shaped, on short conical projections, with 9-12 bulbs distributed more or less in circle or more irregularly. Puparia white or yellowish white, 2.1 - 2.5 mm long.

Mine. – Larvae miners on *Erigeron philadelphicus* L., when in basal rosettes mostly entering more than one leaf before completing development. Mine (Fig. 49) partly in petiole and basal part of midrib of leaf (and partly in adjacent stem in the case of mines formed in stem-leaves), with linear channels, on upper or lower surface or (mostly) more or less full-depth, radiating into leaf parenchyma, appearing whitish in reflected light when fresh; faeces deposited as fine particles, in most mines partly forming beaded strips. Puparium with its ventral surface adjacent to surface of leaf, with its anterior spiracles projecting ventrally through epidermis, in most cases formed in petiole (on upper or lower surface); on lower surface if formed in leaf blade.

Types. – Holotype ♂, 3 ♂♂ 5 ♀♀ paratypes from larvae and puparia 4.ix.69 on *Erigeron philadephicus* L., Liard Hot Springs (59° 10′ N, 126° W), British Columbia, emerged 8.ix-4.x.69, leg. G. C. D. Griffiths. 1 ♂ 2 ♀♀ paratypes from larvae and puparia 15- 22.vii.71 on *Erigeron philadelphicus* L., Elk Island National Park, Alberta, emerged 30.vii-1.viii.71, leg. G. C. D. Griffiths. 1♂ 1♀ paratypes from larvae 1.vi.75 on *Erigeron philadelphicus* L., George Lake Field Station, Alberta, emerged 12-15.vi.75, leg. G. C. D. Griffiths.

Remarks. – The name *thermarum* ("of the hot springs") refers to the type locality, Liard Hot Springs, where this species is abundant. Here its host-plant grows on tufa terraces and on the edge of hot pools (with water temperatures up to 40° C). The late emergence dates of the type series indicate that at least one additional generation occurs in autumn in this thermally favoured habitat. The rich vegetation of these hot springs and the surrounding area has been treated by Porsild & Crum (1959).

I can also report this species from the Edmonton area, where I have noted the mines as common on *Erigeron philadelphicus* L. in the valleys of Whitemud and Blackmud Creeks during June 1975.

Some unclarified or incomplete records

Additional unclarified or incorrect records, not mentioned in the preceeding text, are as follows.

1. *Phytomyza tripolii* de Meijere (1924: 148). De Meijere (1924) has described this species on the basis of a specimen allegedly bred from *Aster tripolium* L. in Holland. I am not able to interpret this species. Hendel (1936: 520) reported that the holotype male was an unpigmented and partly shrunken teneral specimen. He was not even certain to which genus it belonged, since

he could not determine the curvature of the orbital setulae. His conclusion that the species was probably a *Paraphytomyza* (*"Phytagromyza"*) rested solely on the authority of de Meijere's statement that these setulae were curved upwards, a statement which can hardly command confidence if Hendel could not confirm it by observation. No flies agreeing with de Meijere's description have subsequently been obtained from *Aster tripolium* L. among the numerous breedings of K. A. Spencer and myself in the British Isles and of M. von Tschirnhaus in Schlewsig-Holstein. So there is a strong suspicion that de Meijere's data may have been confused. Unfortunately the holotype can no longer be found either in de Meijere's or in Hendel's collections. In this circumstance I can only regard *Phytomyza tripolii* de Meijere as a *nomen dubium.* If the holotype turns up one day, it will be possible to establish its identity by dissection of the genitalia (which in agromyzids are fully pigmented before emergence, and thus allow teneral specimens to be identified without special difficulty).

2. *Phytomyza insperata* Hendel (1927: 262). Hendel (1927) described this species on the basis of a female allegedly bred from *Solidago virgaurea* L. at Bisamberg (near Vienna), Austria. Subsequently (Hendel, 1935: 482) he concluded that his data were probably in error, and synonymized the species with *Phytomyza sonchi* Robineau-Desvoidy, the well-known miner of Compositae Cichorieae. Spencer (1965: 254) now regards *Phytomyza marginella* Fallén as a prior name for this species. I have seen the holotype of *P. insperata* and accept Hendel's (1935) opinion.

3. I have traced no bred material from Eastern North America. There are published records of mines of "*Phytomyza albiceps* Meigen" on several *Aster* and *Solidago* species there (Frost, 1924). This identification can be taken to indicate species of the *Phytomyza albiceps* group, but not the true *P. albiceps* Meigen (an exclusively European species). The two types of mine on *Aster macrophyllus* L. in Quebec figured by Spencer (1969: 283) are probably also attributable to species of the *P. albiceps* group.

4. Sasakawa (1961: 453) has listed *Aster trinervius* Roxb. as a host of the Japanese species which he identified (incorrectly) as *Phytomyza homogyneae* Hendel. See my note on Part VI (Griffiths, 1974b: 115). The identity of the species concerned cannot be established without further information. *Aster* and *Homogyne* seems to me an unlikely host combination, since the latter belongs to the Senecioneae.

POSTSCRIPT

In an effort to repeat the breeding of *Phytomyza solidaginivora* Spencer, I paid special attention last summer to mines on *Aster modestus* Lindl. I did not succeed in this objective, so my identification of this plant as the true host of *P. solidaginivora* remains provisional. I did however succeed in breeding a new species of *Phytomyza* from this plant in the Swan Hills, an area to the northwest of Edmonton characterized by higher rainfall and a shorter growing season than the lowland boreal forest of Central Alberta. These hills form a refugium for many subarctic and cordilleran species. *Aster modestus,* which is very local in the Edmonton region, is the most common species of *Aster* in the Swan Hills, and was the only species noted at elevations above 3500 feet. The new *Phytomyza* bred from it is clearly to be grouped with *P. asterophaga* Spencer and *P. ciliolati* Spencer, as indicated by the synapomorphous structure of the aedeagus (spinules situated near base of basal section on area of weakly pigmented sclerotization confluent with right basal sclerite).

Phytomyza anserimontis new species

Adult. – As described for *P. asterophaga,* except as follows.

Anterior ori about half as long as posterior ori, with short third (anteriormost) pair of ori in female paratype. 3 - 4 upcurved peristomal setulae. 10 - 12 presutural ia; 6 - 7 postsutural ia. Costal ratio mg_2/mg_4 2.45 (♂), 2.7 (♀). Wing length: ♂, 2.5 mm; ♀, 2.8 mm.

Orbits somewhat infuscated (brownish) along eye margins; lunule also infuscated in female paratype. Mesonotum with postalar callus distinctly whitish, and in holotype with traces of pale coloration also at corners of sutural triangle (but in female paratype scarcely paler here).

Aedeagus (Fig. 51) with area of weakly pigmented sclerotization confluent with right basal sclerite longer and bearing two separate groups each of 3 - 4 stout spinules (7 spinules in total); distal section entirely unpigmented.

Puparium and third instar larva. – Similar to those of *P. asterophaga,* but with more numerous spiracular bulbs. Anterior spiracles with about 15 bulbs; posterior spiracles with 20 - 26 bulbs, arranged more or less in broad oval ellipse or partly in irregular stellate pattern. Puparia 1.9 - 2.1 mm long.

Mine. – Larvae leaf-miners on *Aster modestus* Lindl. Mine (Fig. 50) entirely linear, 25 - 30 cm long, 1.5 - 2 mm wide terminally; faeces deposited mostly in long black threads on alternate sides of mine (with breaks where they alternate from one side to the other, not more or less continuous throughout mine as in *P. ciliolati*); mine formed largely on upper surface of leaf (where appearing greenish white in reflected light when fresh), but with initial channel on lower surface; larvae leaving leaf through semicircular slit on lower surface before puparium formation.

Types. – Holotype ♂, 1 ♀ paratype from larvae 14-15.viii.75 on *Aster modestus* Lindl., Goose Mountain (54° 45′N, 116° 2′W at 4450 feet elevation), Swan Hills, Alberta, emerged 26-27.iv.76, leg. G.C.D. Griffiths.

Remarks. – This species is evidently univoltine, with the larvae feeding much later than its likewise univoltine relative *P. asterophaga.* It is not confined to high elevation in the Swan Hills region, as I also collected a few larvae on the Sakwatamau River (54° 25′N, 116° 5′W) at only 2800 feet elevation (24.viii.75).

The mines of *P. anserimontis* were recognized in the field as different from those of *P. ciliolati,* which I have also found on *Aster modestus,* on account of their greater length and different faecal pattern. The different size of the puparia will also help to distinguish these species. I did not find *P. ciliolati* at the sites where *P. anserimontis* was collected, perhaps because as a multivoltine species it is less well adapted to areas with a very short growing season.

The specific epithet *anserimontis* ("of Goose Mountain") refers of course to the type locality.

ACKNOWLEDGEMENTS

I am grateful to B. Cooper (Biosystematics Research Institute, Ottawa), R. Lichtenberg (Naturhistorisches Museum, Vienna), H. Schumann (Zoologisches Museum, Humboldt University, Berlin), K. A. Spencer (Callington, Cornwall, U. K.) and H. Zoerner (Dessau) for the loan of material for study. M. von Tschirnhaus and M. Beiger were kind enough to give me specimens of *Chromatomyia asteris* (Hendel) and *Phytomyza simmi* Beiger respectively. A. C. Pont and J. P. Dear of the British Museum (Natural History) provided information on the Hering mine herbarium. Financial support for my field work in the Yukon Territory and northern British Columbia was received from the Boreal Institute of the University of Alberta and the Professor Hering Memorial Research Fund.

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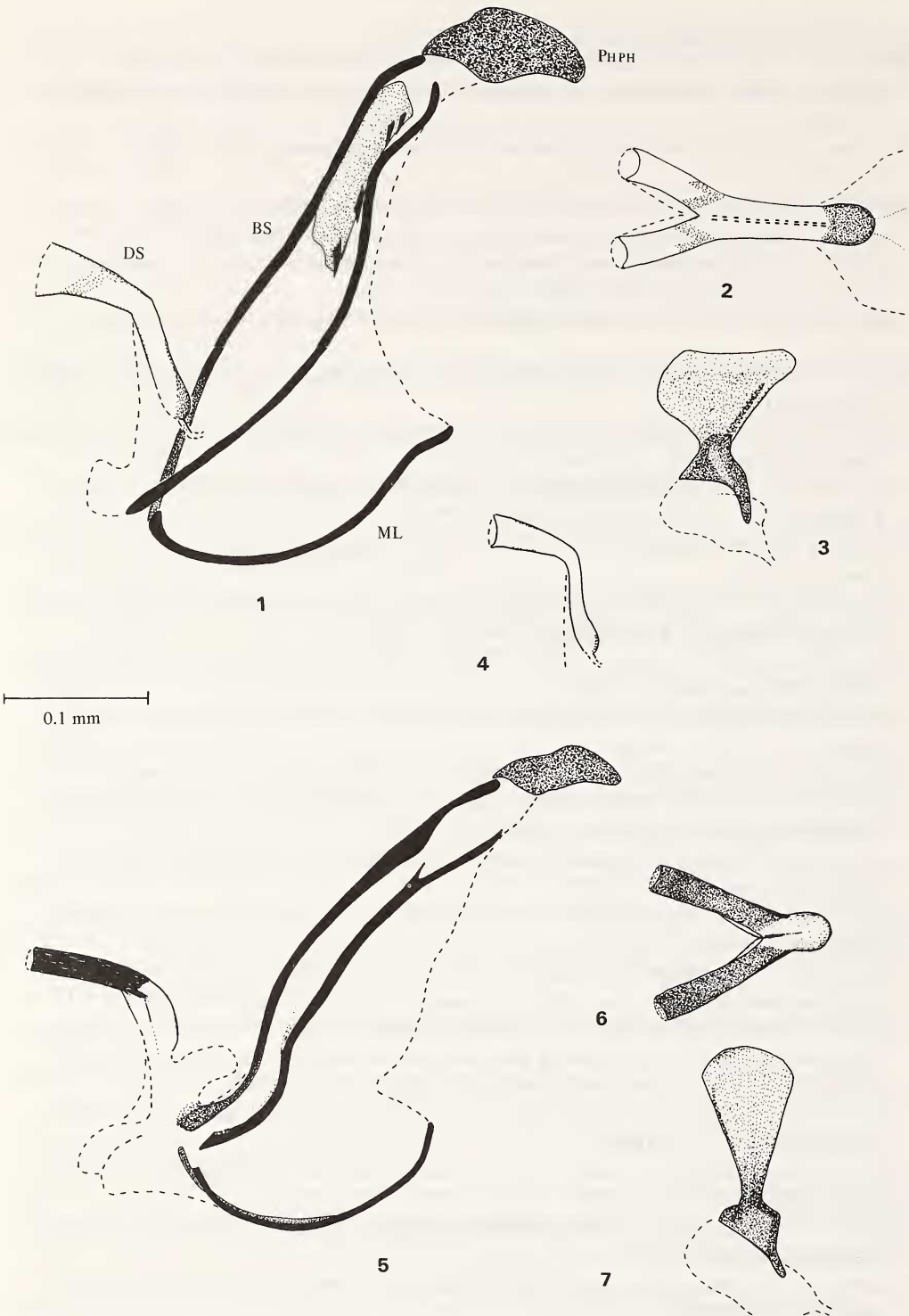


Fig. 1-3. *Phytomyza asterophaga* Spencer (♂): 1, aedeagus in left lateral view (BS basal section of aedeagus, DS distal section of aedeagus, ML medial lobe, PHPH phallophore); 2, distal section of aedeagus in ± anteroventral view; 3, ejaculatory bulb and apodeme. Fig. 4. *Phytomyza ciliolati* Spencer (♂), distal section of aedeagus in left lateral view. Fig. 5-7. *Phytomyza despinosa* n. sp., holotype ♂:5, aedeagus in left lateral view; 6, distiphallus in dorsal view; 7, ejaculatory bulb and apodeme.

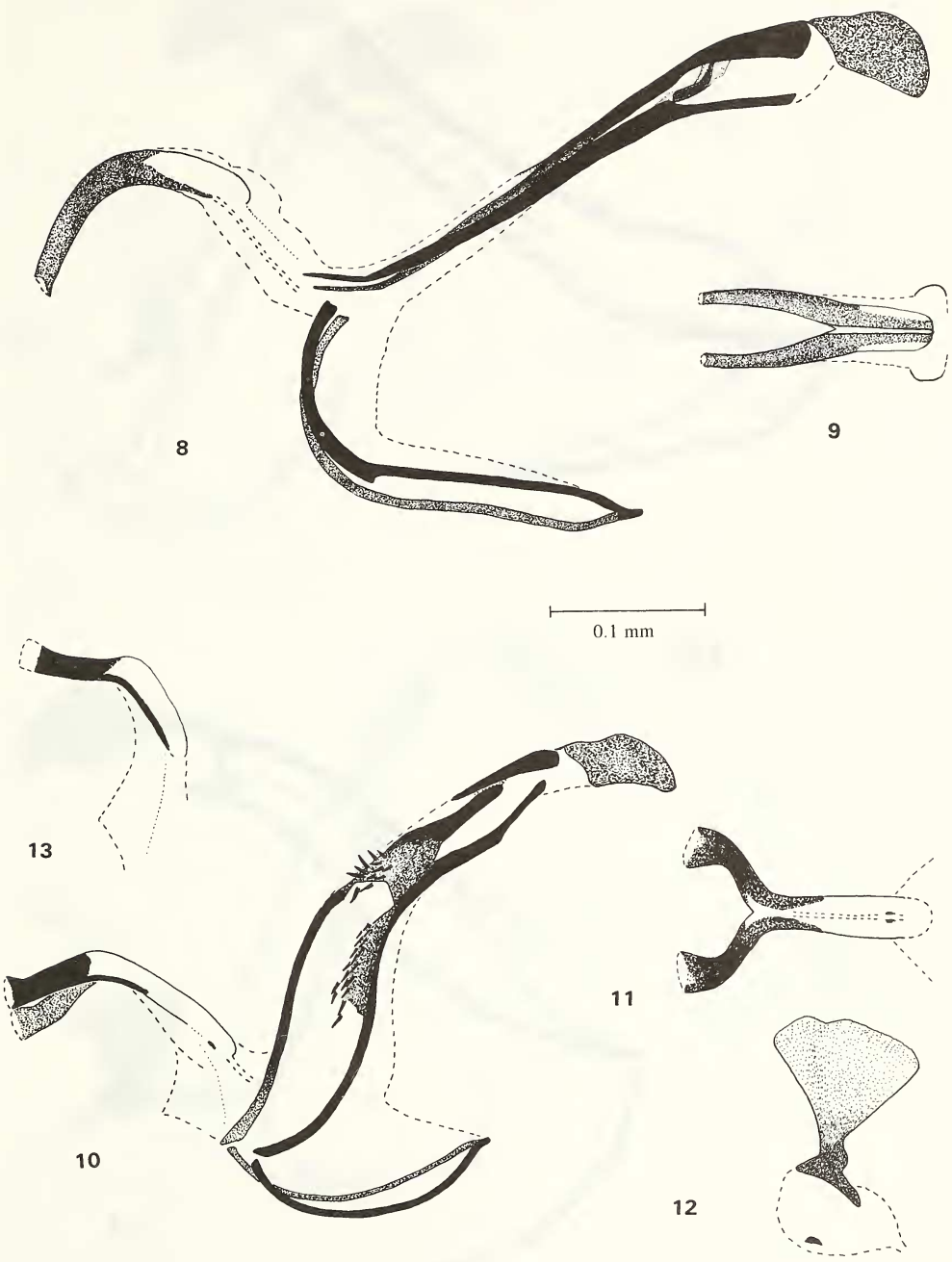


Fig. 8-9. *Phytomyza solidaginivora* Spencer, holotype ♂: 8, aedeagus in left lateral view; 9, distiphallus in ± anterodorsal view. Fig. 10-12. *Phytomyza phalangites* n. sp., holotype ♂: 10, aedeagus in left lateral view; 11, distal section of aedeagus in ventral view; 12, ejaculatory bulb and apodeme. Fig. 13. *Phytomyza astotinensis* n. sp. (holotype ♂), distal section of aedeagus in left lateral view.

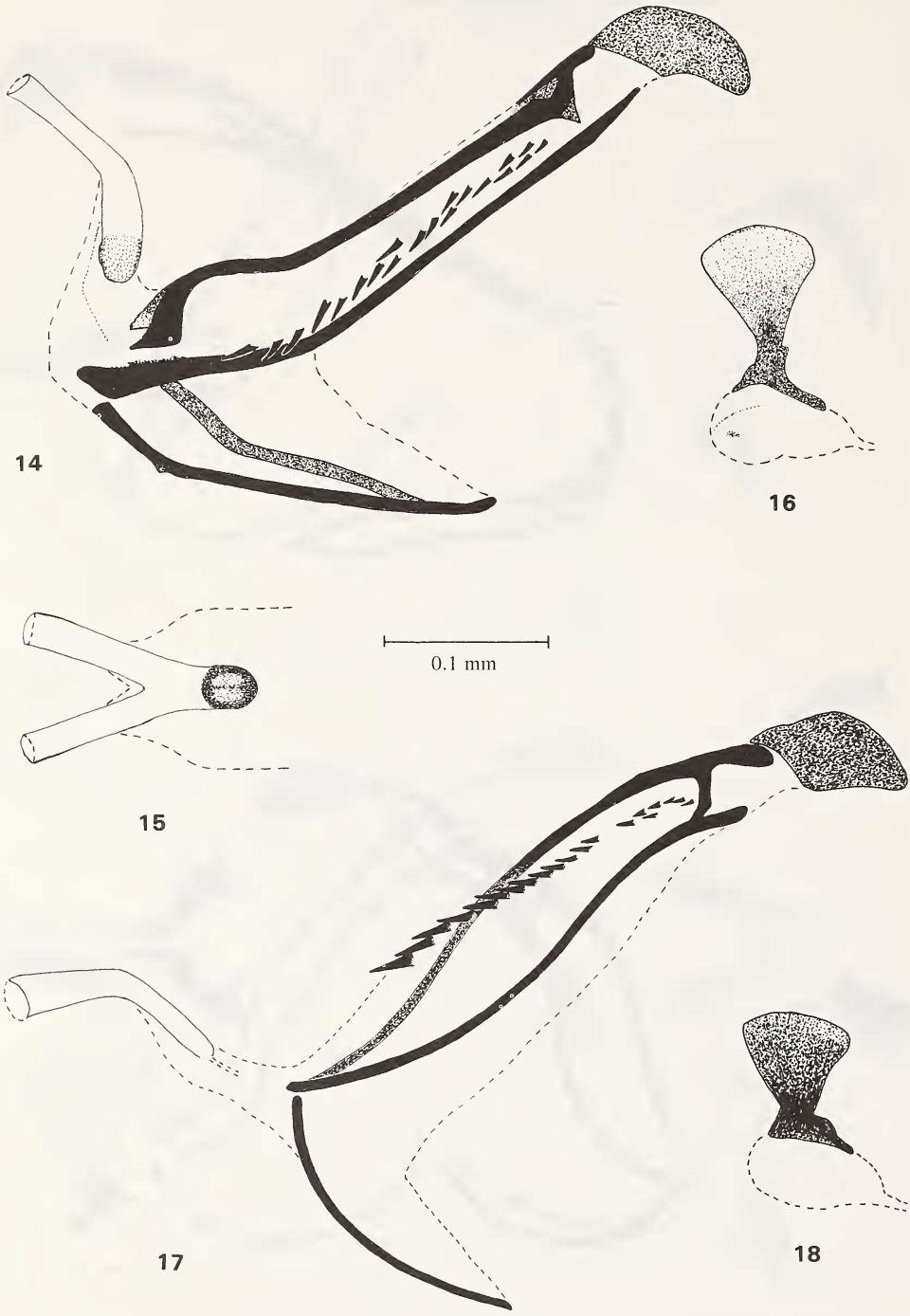
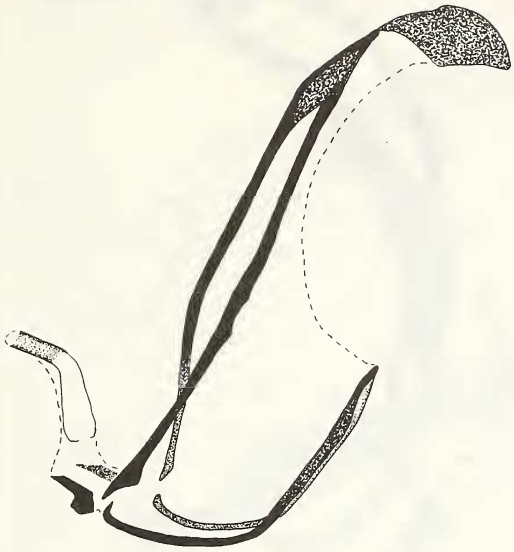


Fig. 14-16. *Phytomyza virgaureae* Hering, syntype ♂: 14, aedeagus in left lateral view; 15, distal section of aedeagus in ± anteroventral view; 16, ejaculatory bulb and apodeme. Fig. 17-18. *Phytomyza solidaginophaga* Sehgal (♂), Jasper: 17, aedeagus in left lateral view; 18, ejaculatory bulb and apodeme.



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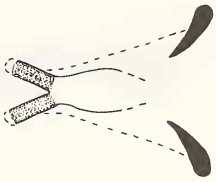

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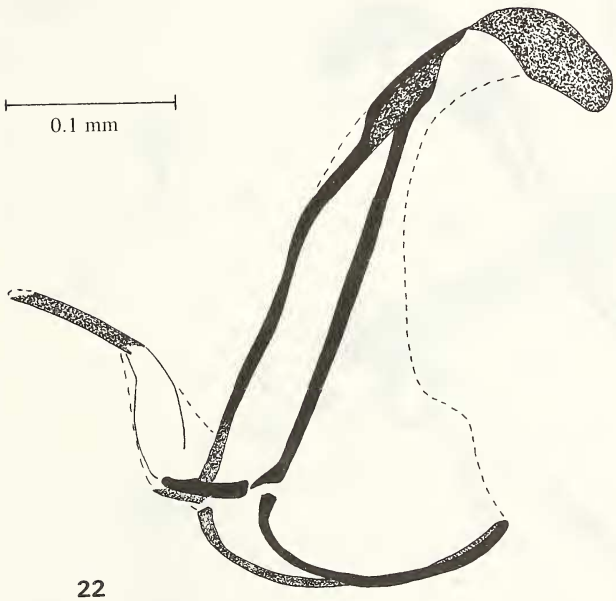

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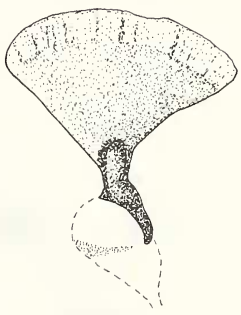

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Fig. 19-21. *Phytomyza bellidina* Hering, paratype ♂: 19, aedeagus in left lateral view; 20, distal section of aedeagus in ± anteroventral view; 21, ejaculatory bulb and apodeme. Fig. 22-23. *Phytomyza hoppi* Hering, paratype ♂: 22, aedeagus in left lateral view; 23, ejaculatory bulb and apodeme.

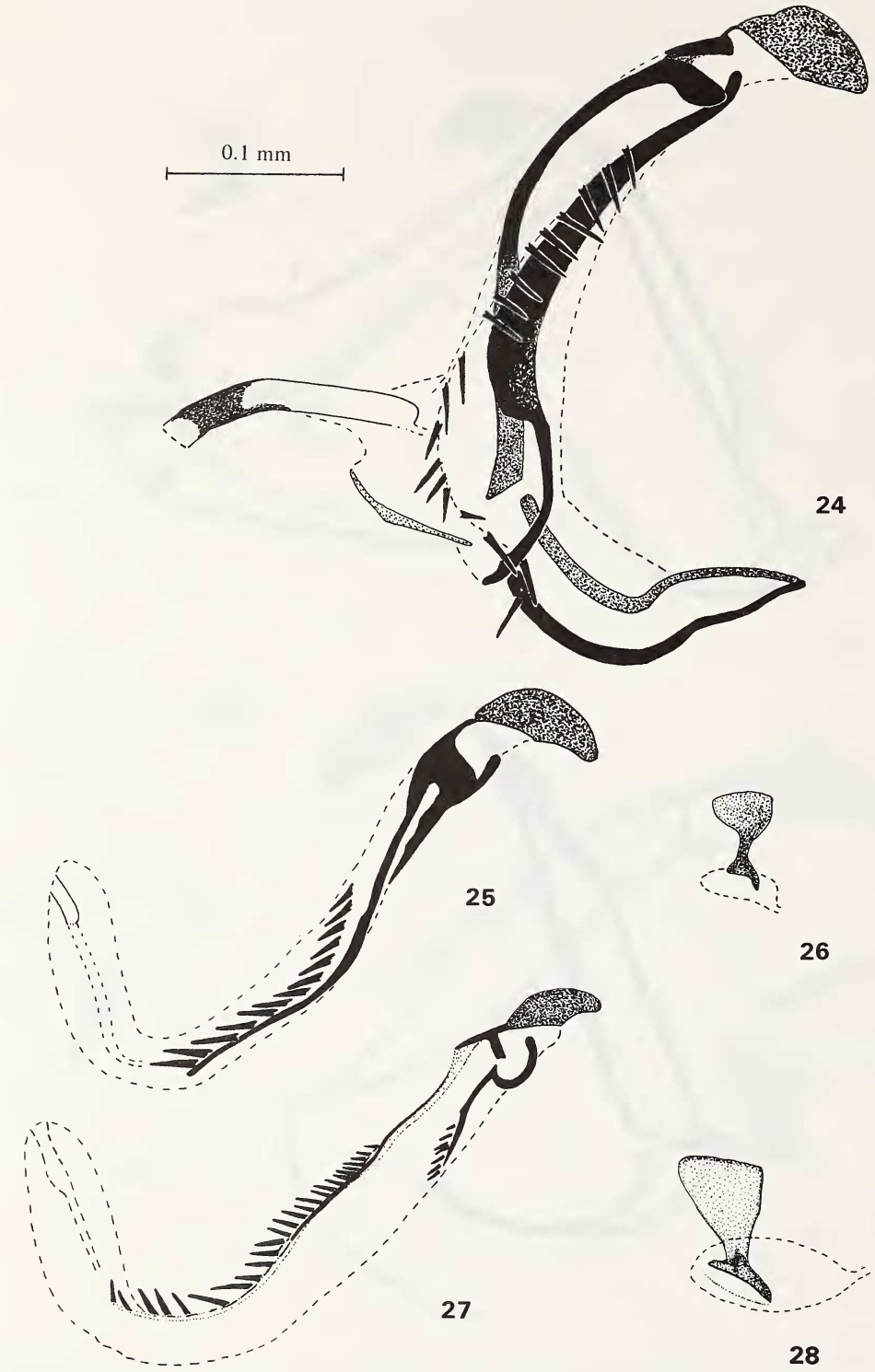

Fig. 24. *Phytomyza ovimontis* n. sp. (holotype ♂), aedeagus in left lateral view. Fig. 25-26. *Phytomyza erigerophila* Hering (♂), Scotford Sandhills, Alberta: 25, aedeagus in left lateral view; 26, ejaculatory bulb and apodeme. Fig. 27-28. *Phytomyza solidaginis* Hendel (♂) from Hendel collection: 27, aedeagus in left lateral view; 28, ejaculatory bulb and apodeme.

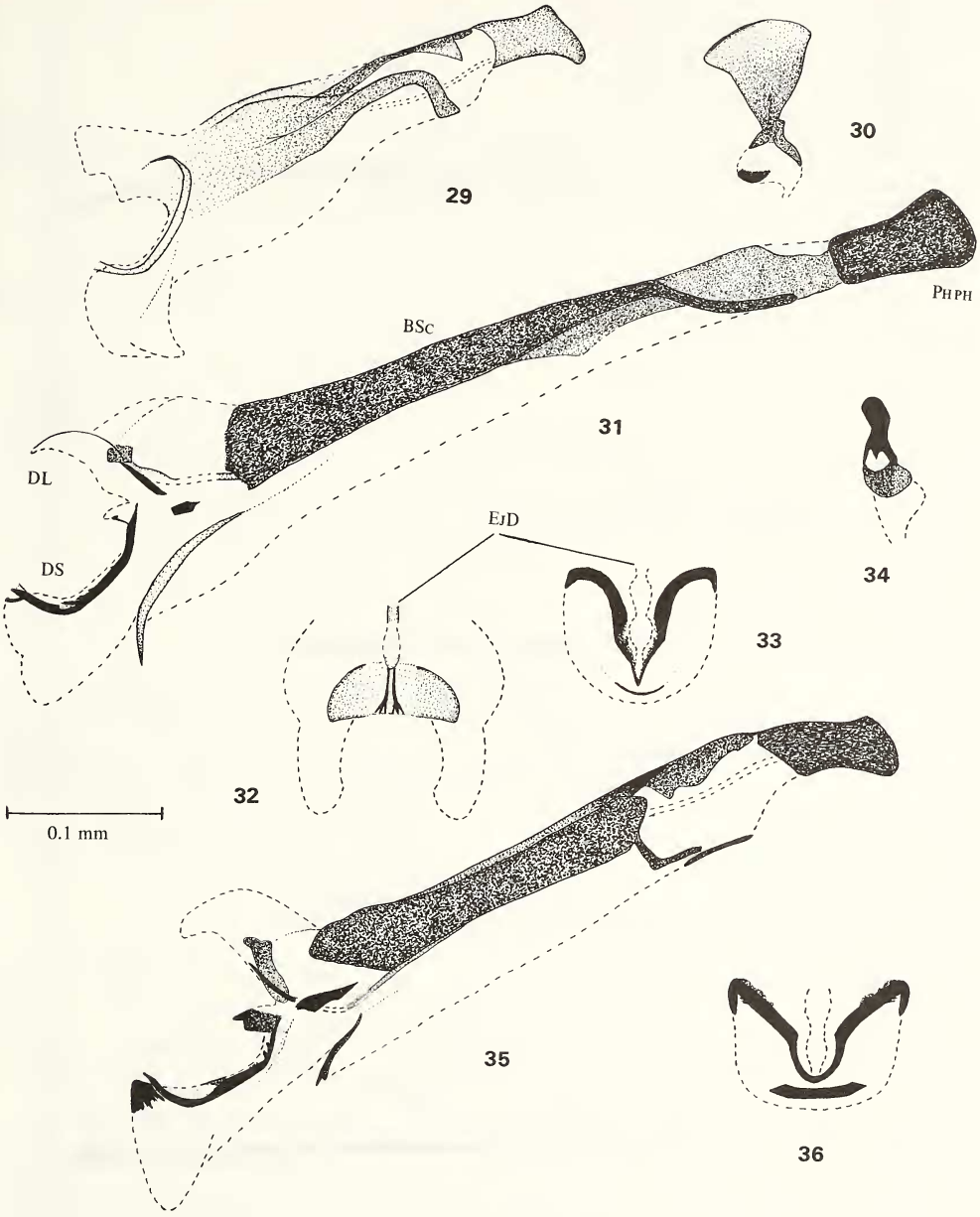

Fig. 29-30. *Chromatomyia asteris* (Hendel), holotype ♂: 29, aedeagus in left lateral view; 30, ejaculatory bulb and apodeme. Fig. 31-34. *Chromatomyia erigerontophaga* (Spencer), paratype ♂ (Peary Land) (BSC basal sclerites, DL dorsal lobe of aedeagus, DS distal section of aedeagus, EJD ejaculatory duct, PHPH phallophore): 31, aedeagus in left lateral view; 32, dorsal lobe of aedeagus in ± posterodorsal view; 33, distal section of aedeagus in ± dorsal view; 34, ejaculatory bulb and apodeme. Fig. 35-36. *Chromatomyia thermarum* n. sp., holotype ♂: 35, aedeagus in left lateral view; 36, distal section of aedeagus in ± dorsal view.

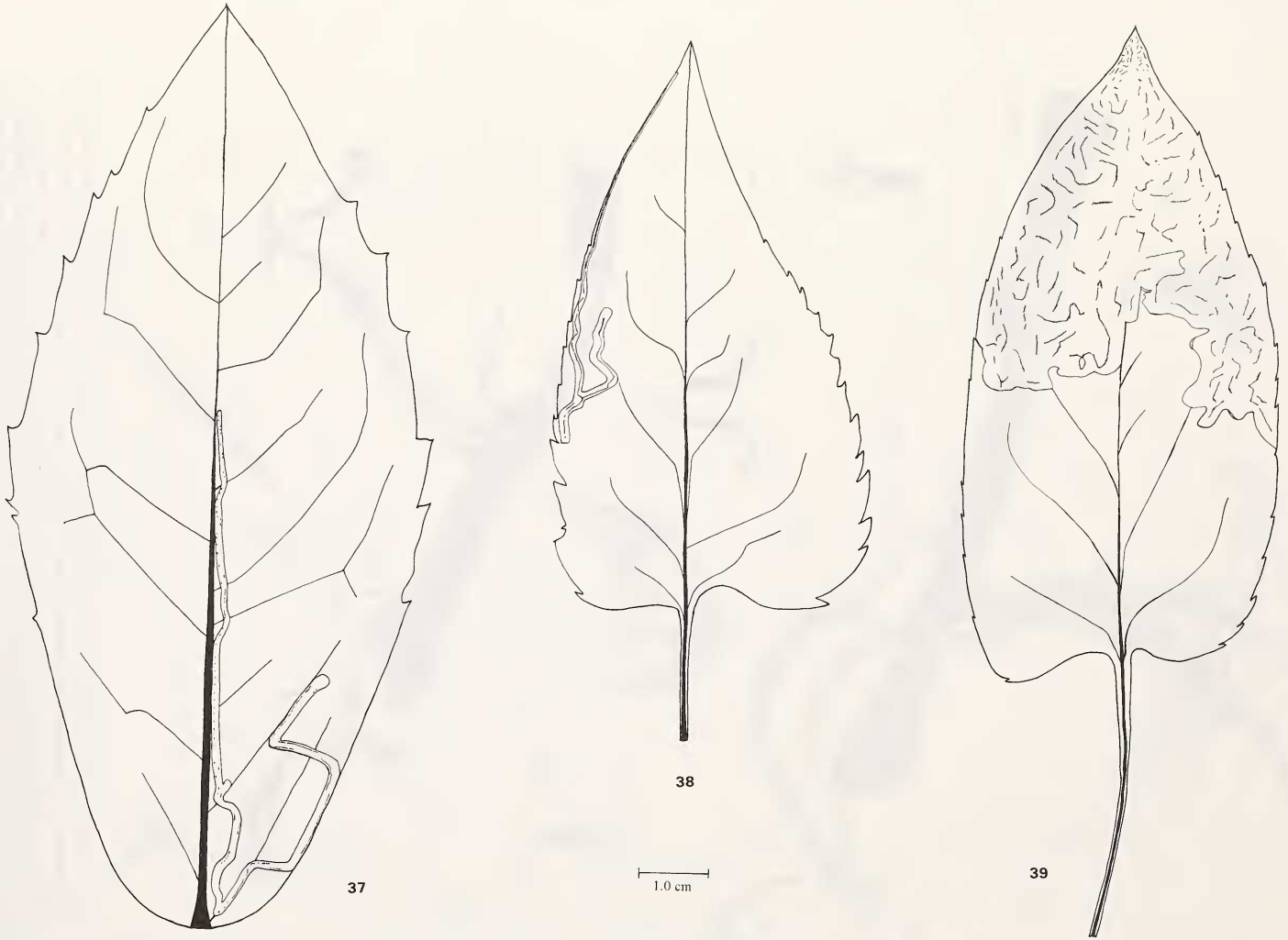

Fig. 37. Leaf of *Aster conspicuus* Lindl. with mine of *Phytomyza asterophaga* Spencer. Fig. 38-39. Leaves of *Aster ciliolatus* Lindl. with mines of: 38, *Phytomyza ciliolati* Spencer; 39, *Phytomyza phalangites* n. sp. (communal mine).

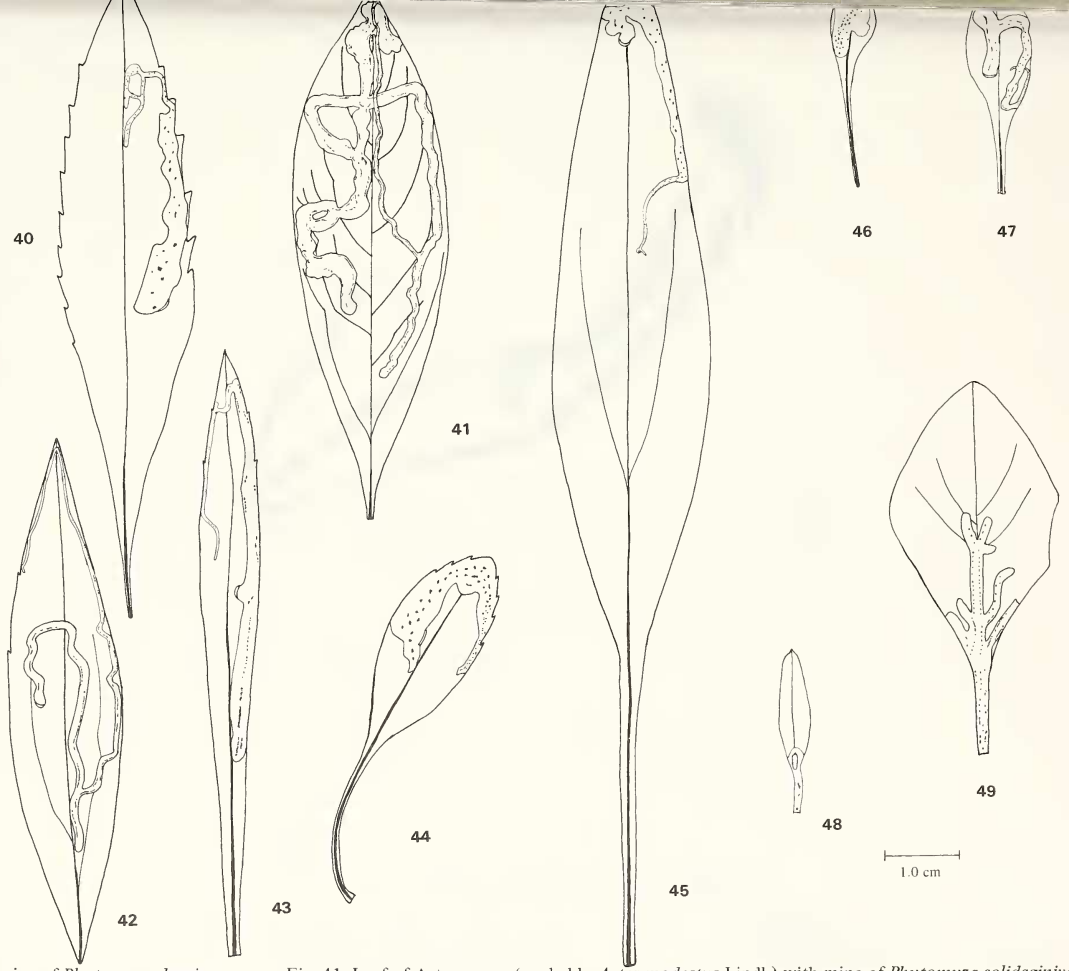

Fig. 40. Leaf of *Aster sibiricus* L. with mine of *Phytomyza despinosa* n. sp. Fig. 41. Leaf of Astereae sp. (probably *Aster modestus* Lindl.) with mine of *Phytomyza solidaginivora* Spencer. Fig. 42-43. Leaves of *Solidago canadensis* L. with mines of: 42, *Phytomyza astotinensis* n. sp.; 43, *Phytomyza solidaginophaga* Sehgal. Fig. 44. Leaf of *Solidago multiradiata* Ait. with mine of *Phytomyza scopulina* n. sp. Fig. 45. Leaf of *Erigeron peregrinus* (Pursh) subsp. *callianthemus* (Greene) with mine of *Phytomyza peregrini* n. sp. Fig. 46. Leaf of *Erigeron caespitosus* Nutt. with mine of *Phytomyza ovimontis* n. sp. Fig. 47. Leaf of *Erigeron glabellus glabellus* Nutt. with mine of *Phytomyza erigerophila* Hering. Fig. 48. Leaf of *Erigeron eriocephalus* J. Vahl with terminal part of mine of *Chromatomyia erigerontophaga* (Spencer). Fig. 49. Leaf of *Erigeron philadelphicus* L. with mine of *Chromatomyia thermarum* n. sp.

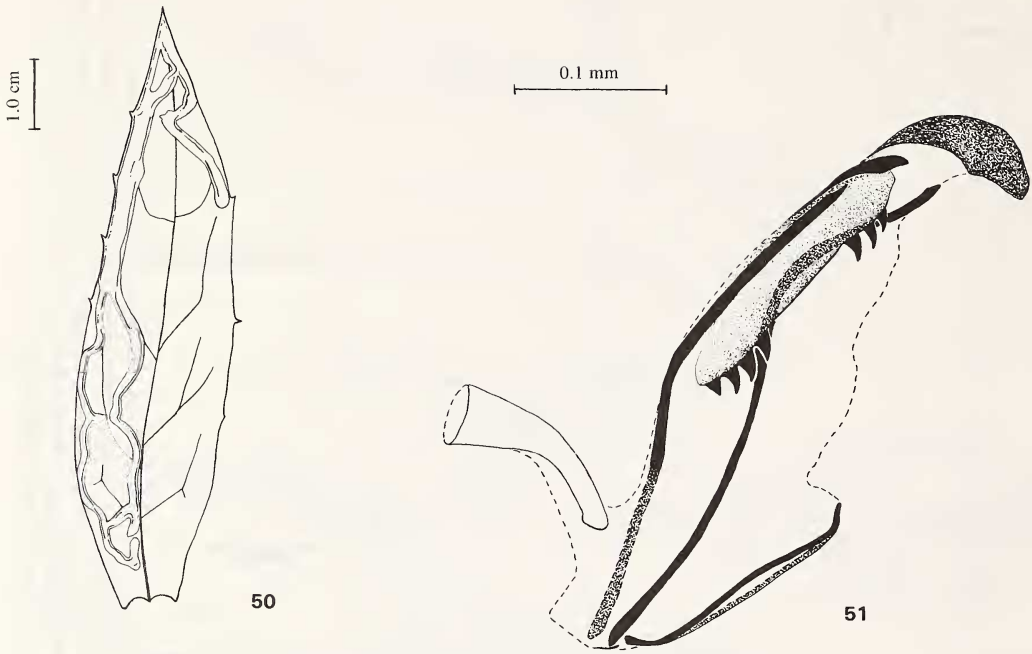

Fig. 50. Leaf of *Aster modestus* Lindl. with mine of *Phytomyza anserimontis* n.sp. Fig. 51. *Phytomyza anserimontis* n.sp. (holotype ♂), aedeagus in left lateral view.